MECHANICAL ENGINEERING

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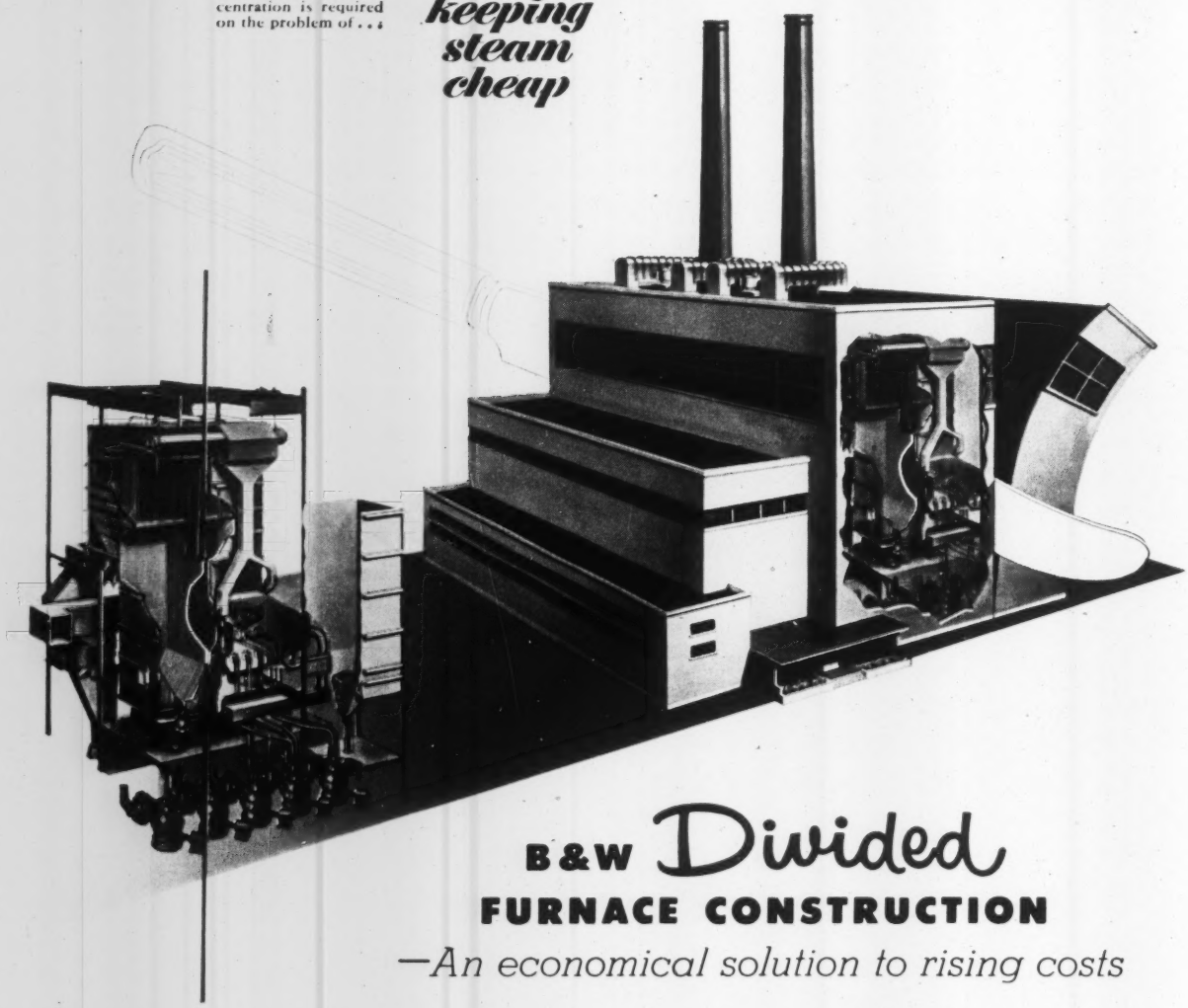
Steam is literally the life-blood of our American economy. Through it, the energy in our store of fuels is made available in useable form. Steam always has been taken for granted because it's cheap. But, with rising construction costs making steam plants more expensive, major engineering concentration is required on the problem of . . .

keeping steam cheap



B&W Divided FURNACE CONSTRUCTION

—An economical solution to rising costs

BENEFITS OF DIVIDED FURNACE CONSTRUCTION

- Provides greater cooling area in smaller furnace volume
- Reduces steel and other material costs by keeping boiler and building volume to a minimum
- Lowers furnace construction costs
- Cuts operating costs by reducing slagging in furnace and in convection surface

When fifty to one hundred tons of coal are burned in one boiler in a single hour, the tremendous amount of energy released is difficult to control. To harness this vast outpouring of heat and chill the tons of ash particles to the required temperature, huge furnaces, often 10 to 15 stories high, are needed.

With rising costs of materials and labor, engineers have long sought a way to reduce the size both of boiler furnaces and of the buildings that house them. Division walls were an apparent answer . . . but serious obstacles stood in their way. It was not until B&W's inventions in the field of boiler circulation solved these problems that the divided furnace became a simple, economical answer to rising construction costs. Already, over 75 B&W Boiler units with this important feature are in operation . . . and more than 80 additional units are under construction. All represent savings in size and cost of structure.

Keeping steam cheap . . . for public utilities and for industrial users . . . is a prime engineering objective at B&W, a major aim of our never-ending research and development program. The B&W Divided-Furnace construction is typical of many B&W cost-saving advantages worth investigating.

BABCOCK & WILCOX

BOILER DIVISION

N-150

● The "third degree" is but a superficial scanning compared to the trials a ball bearing must withstand in New Departure's Research Laboratory. Here, under conditions which pack years of normal use into a short time, engineers determine how to make the best ball bearings even better.

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Three decades of this search and research have produced the sealed rear wheel-bearing for motor cars, the self-sealed bearing for farm implement use, the tiny, jewel-like bearing for delicate instruments . . . and many other types to fit a host of applications.

You can specify New Departures and *know* that they are right for the job. Keep your eye on the BALL to be sure of your BEARINGS!

Vibration analyzer eliminates human error in scientific search for causes of noise in bearings.

New Departure ball bearings are readily available at your equipment dealer or bearing distributor —supplied from the industry's largest network of warehouse stocks.

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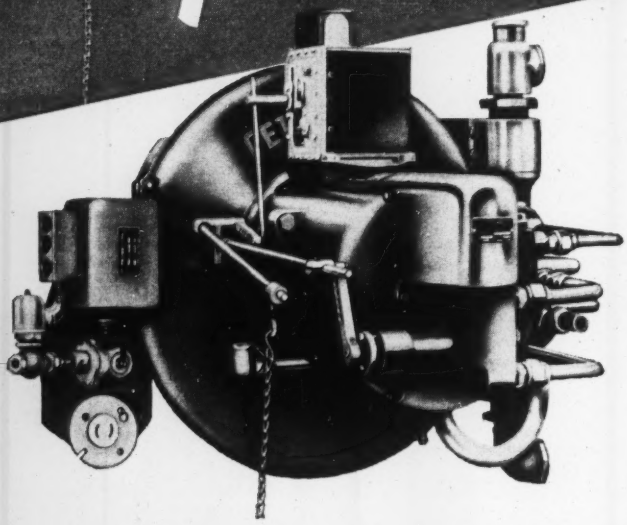
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Also Makers of the Famous New Departure Coaster Brake

MECHANICAL ENGINEERING, March, 1953, Vol. 75, No. 3. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢, to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations

Have you a steam problem?



A Petro INDUSTRIAL OIL BURNER IS THE SOLUTION

Petro industrial oil burners are your best buy! They operate with high efficiency in practically every type of boiler.

Petro oil burners have world-wide acceptance. Their dependability is traditional. They are recommended by leading heating contractors everywhere. Fifty years in oil firing gives the Petro organization an exceptional degree of engineering experience and practical "know how."

Petro's outstanding ability to burn heavy, low-cost oils with maximum efficiency has reduced fuel costs in thousands of plants and buildings.

See Petro section in Sweet's Architectural File, or write for catalog and specifications to Petro, 3174 W. 106th St., Cleveland 11, Ohio.

HERE'S WHAT YOU NEED

You need to CUT STEAM COSTS

A Petro industrial oil burner will do it! The Petro burner is designed to burn low-cost heavy fuel oil with high efficiency and complete reliability. Saves money year after year.

You need to CUT LABOR COSTS

A Petro oil burner will do that, too! Completely automatic, it regulates itself without constant attention; frees attendants for other duties.

You need to MEET FLUCTUATING STEAM DEMANDS

A Petro industrial oil burner does just that! The fire can be modulated to meet the most extreme requirements of varying steam loads.

You need to do all this AT LOW COST without replacing your present boiler equipment.

INDUSTRIAL, COMMERCIAL and RESIDENTIAL OIL BURNERS FOR EVERY FIRING NEED

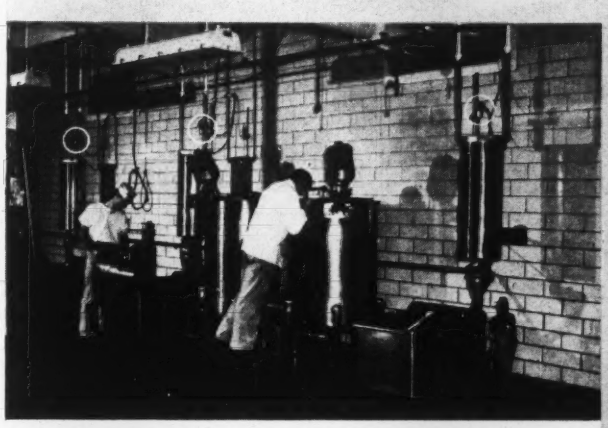
50 Years of Leadership in Automatic Heating and Power Equipment

PETRO

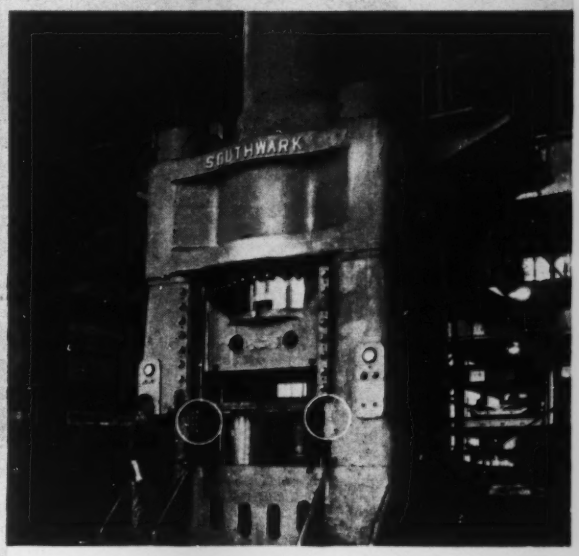
3174 W. 106th St., Cleveland 11, Ohio

"Electron-eering" *with* photoswitch controls

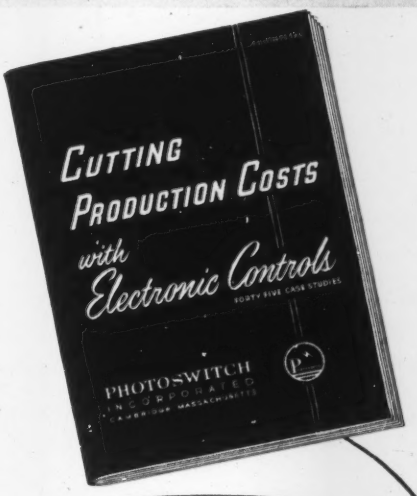
Your next step in
control-efficiency



Precision for taste— Three electronic liquid level controls maintain the flow of precise quantities of fruit juices for perfect flavoring of jams.



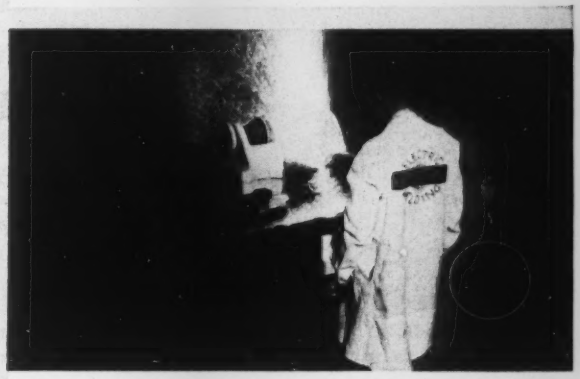
Protection against a giant— Two photoelectric cells control this giant auto body press. If operator's hand breaks light beam, system stops machine.



These facts can save you money . . .

Forty-five case studies, crammed with factual data, tear aside all hocus-pocus and give you a clear understanding of how electronic controls can solve your industrial problems. You'll find valuable ideas in methods by which others have achieved efficiency through "Electron-eered" counting, weighing, measuring, guarding, timing and cycling. (Indexed by industries— textile, paper, metal and others— as well as by applications.)

Photoswitch offices are located in all principal cities



Split-second welding— Electronic timer controls automatic operation precisely. It times and actuates preheat, weld, and postheat annealing.

Photoswitch, Incorporated
Dept. MA3, 77 Broadway, Cambridge 42, Mass.
Send free, "Cutting Production Costs with Electronic Controls".

NAME ..... TITLE .....

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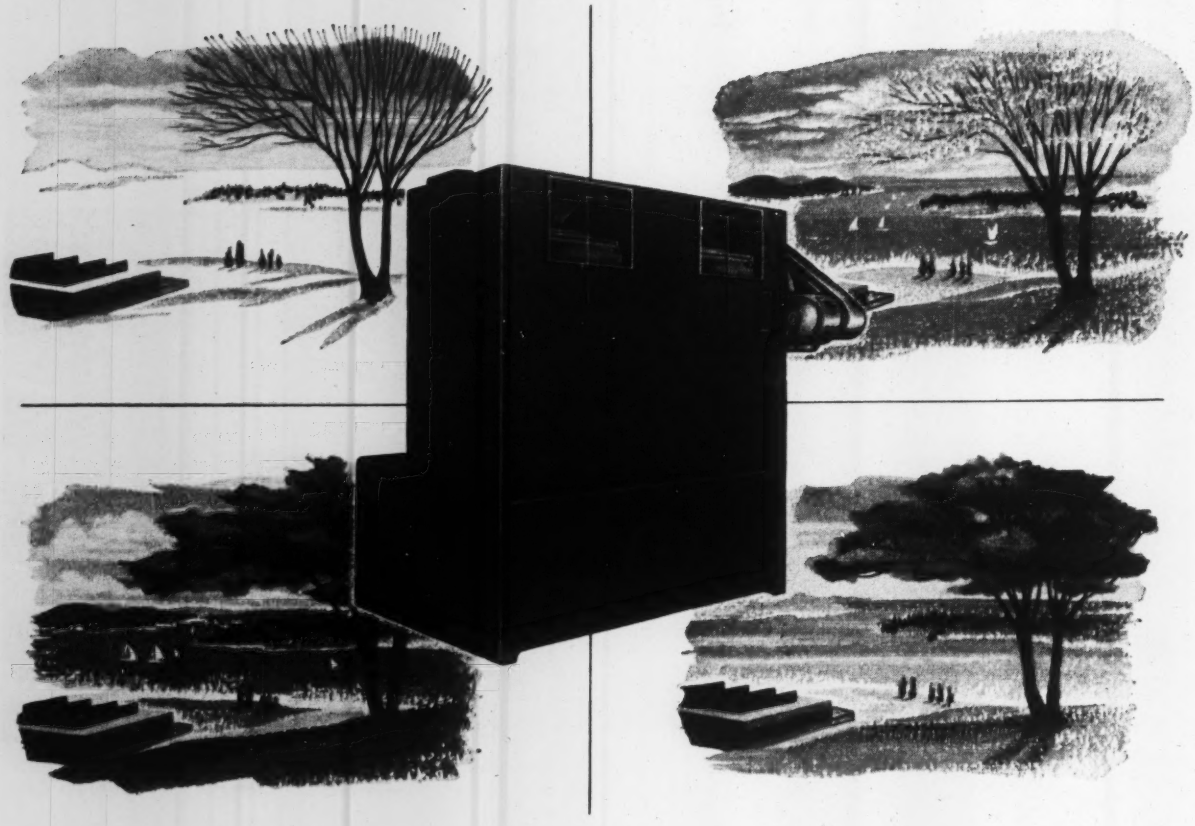
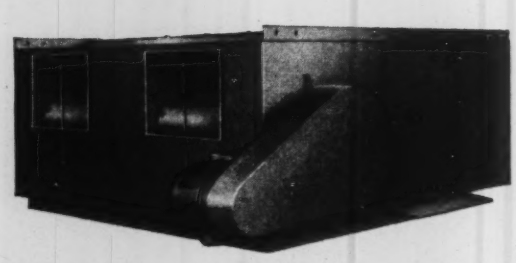
CITY ..... STATE .....

American Blower Air Conditioning Units





American Blower Type A Conditioner. Capacities from 1000 to 13600 cfm. Either direct expanded refrigerants, chilled water, well water or brine can be used for cooling and steam or hot water for heating.

American Blower Air Conditioning units are designed for summer cooling and dehumidifying and winter heating and humidifying.

This dual function by the same piece of equipment results in substantial savings in cost and offers much in comfort.

Three types are available: the Type A Conditioner for normal unitary type applications, the Type S Conditioner for unitary type application where washed air or high relative humidities are required, the Type M Conditioner for central system installation.

For data, consult the nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

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Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

It is vital to maintain *Quality*

Please remember that felt is not just felt, but is an engineering material, which can and should be specified as closely as any other. It is obvious that glass-polishing felt must be different from cushioning felt, but there are finer distinctions which should be taken into account if satisfaction is to be assured.

American, the largest and oldest felt manufacturer, makes 700 different mechanical types, each having exactly-controlled characteristics. For any given application there is a specification felt that is right for the job. To select this felt and establish it as a standard is your assurance of satisfaction with your product or process.

Like other materials, felt should be bought not on price, but on the quality required for a given application. If you will do that by adhering strictly to specifications and material standards you will find felt, American Felt, will serve you supremely well in protecting the reputation of your products. Our engineers will be glad to collaborate with you on establishing the correct specifications, and our mills will adhere strictly to those specifications when your order is received.

American Felt Company

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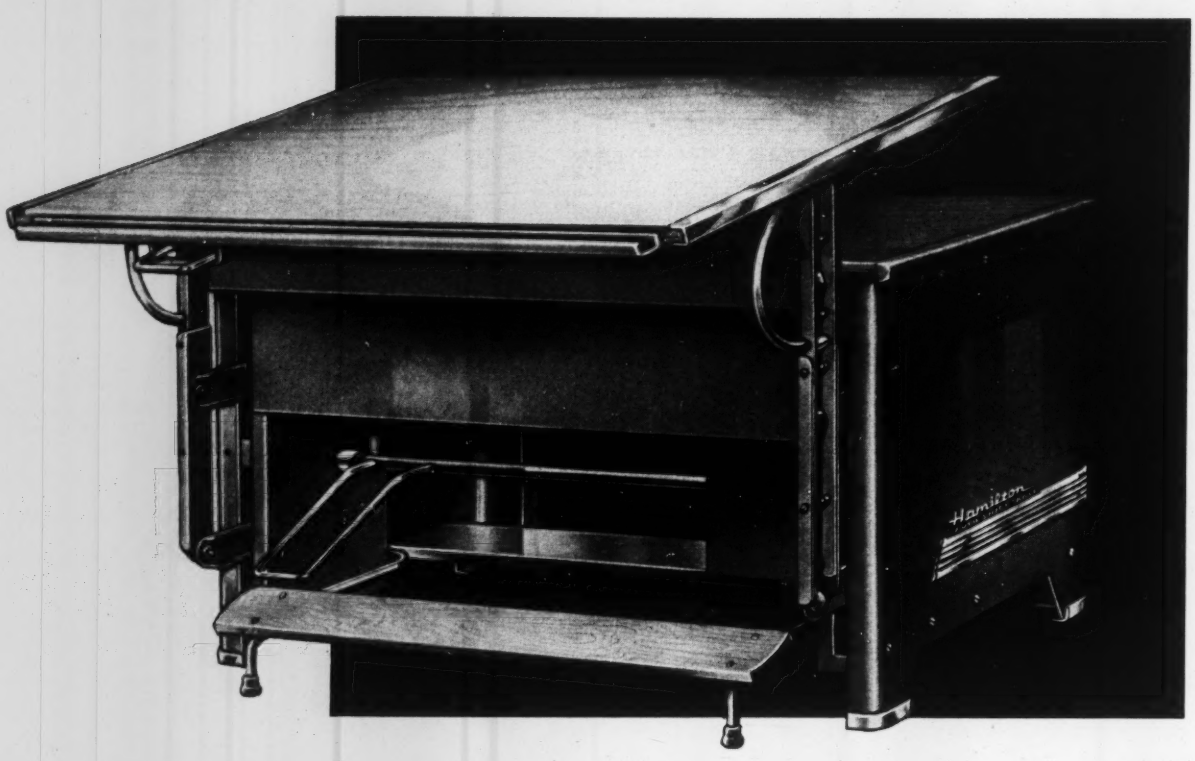

the new Auto-Shift

TM Reg.

by Hamilton

America's most efficient, most *fatigue-free* drafting table has been completely redesigned—improved in many functional details, smartened in appearance and broadened to accommodate an entirely new range of drafting table needs. Yes, the new Auto-Shift line well deserves your interest—for it has been tailored precisely to your needs.

Here are a few highlights. The basic Auto-Shift table is now available in two base sizes, each with two board sizes. For row installations, two new front-end Auto-Shifts (board only) and two new rear-end units (reference desk only) are available. As always, the Auto-Shift features instant, effortless adjustment of board height and slope, and remarkably high floor space efficiency.

You owe it to yourself to find out more about this exceptionally fine drafting table, and Hamilton's new 8-page Auto-Shift brochure is the best possible way to do this. For your free copy, write today to—

Hamilton Manufacturing Company

TWO RIVERS, WISCONSIN

Rome-Turney water-cooled condenser coil. Tube is ⅜" O.D., .042" ga., bent on a 1⅜" centerline diameter. Soldered helical fins are .135" wide, spaced 14 turns to the inch. Other types of heat exchanger coils are also shown. Rome-Turney forms coils out of tube up to 40 feet long, without joints.

For Copper Tube that can be BENT

Rome-Turney sees REVERE

Most of the Revere Metals are fabricated by usual methods into conventional products. Some of them, however, appear on the market in forms that are unusual and possess special advantages. Take these helical-finned copper coils produced by the Rome-Turney Radiator Co., Rome, N. Y. It takes extra skill to produce coils with such small radii. The company can produce the coils shown on a commercial basis, for use in air conditioning apparatus, air compressors, and general heating and cooling applications where compactness plus high heat transfer rates are essential.

How it is possible to make such tight turns is Rome-Turney's secret. Revere does not share in it, nor does Revere want to reveal a secret of its own, which is how we turn out copper tube in a special bending temper for an application such as this. All we can say is that the two methods dovetail very nicely. If you need copper tube that can be bent easily, and offers you as well the advantages of corrosion resistance, high heat transfer, easy joinings, see Revere. We also make copper pipe, tube in copper alloys, aluminum alloys, and electric welded steel tube. If required, the Technical Advisory Service will gladly collaborate with you, as it has with Rome-Turney, on selection and specification matters. Get in touch with the nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

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Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

SEE REVERE'S "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Only DRAVO *Counterflo* Space Heaters offer you these 5 exclusive features:

Ideal for heating large open spaces in industrial, commercial and educational buildings, standard Dravo *Counterflo* Space Heaters have five exclusive advantages over other warm-air space heaters.

1 The Dravo *Counterflo* combustion method takes place in a stainless steel combustion chamber. The exhaust gases from combustion are "whirl-cooled" through two sets of economizer tubes. This four-pass heat transfer results in a minimum heating efficiency of 80%.

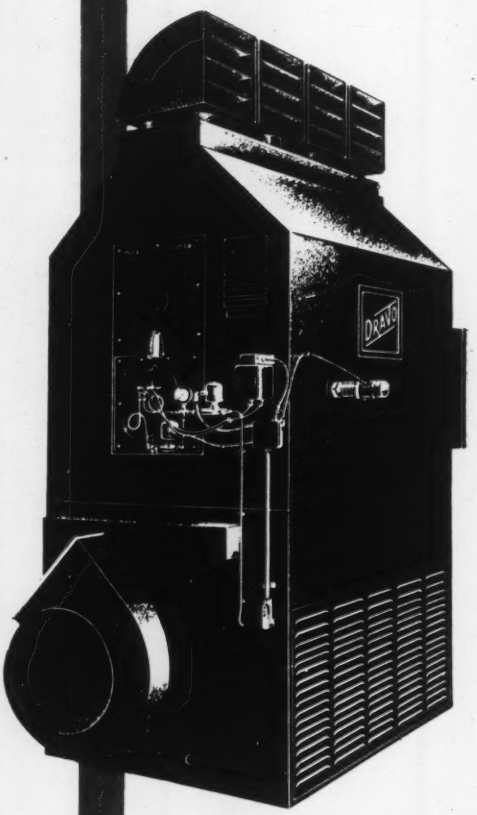
2 One rotor shaft operates all heater fans, thus co-ordinating exhaust, air-intake and heat-discharge systems.

3 Air for combustion is provided by main supply fan; volume and velocity are controlled by an adjustable damper.

4 Approved by American Gas Association and listed by Underwriters' Laboratories, Inc.; Dravo Safety Control Circuit is accepted by Factory Mutual Engineering Division.

5 Burners are designed by Dravo Engineers for top efficiency. Heaters burn gas or oil; burners are interchangeable to take advantage of fuel savings by using the most economical source of supply or in times of shortage the most available fuel.

Dravo *Counterflo* Space Heaters in addition to comfort heating are easily adapted to heat curing and process drying, tempering of replacement air and summertime ventilation. Dravo Heaters can also be tied in with air conditioning systems by making use of the same ductwork.



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Send me information about heating for the subjects I've checked, and Dravo Heater Catalog MN 52

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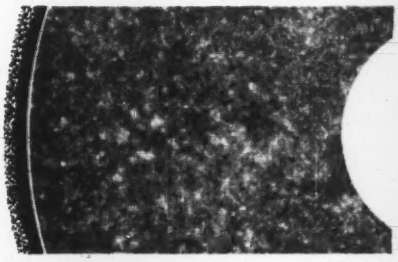
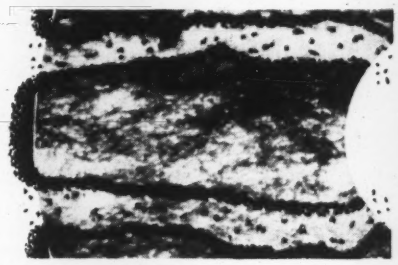
GRADUATED DENSITY

makes MICRO-KLEAN the most effective filter on the market!

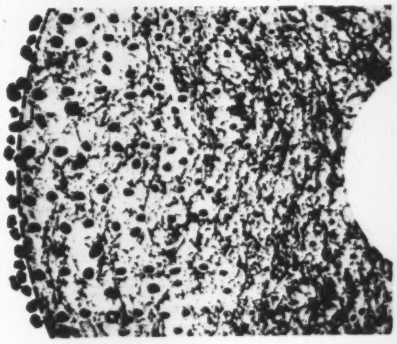
How MICRO-KLEAN compares with other cartridge filters



***Compare* MICRO-KLEAN with FILTERS WITH THE SAME DENSITY THROUGHOUT.** The filter media density is the same on the pressure and discharge surfaces of the element; therefore, dirt accumulation is largely on the outside surface, choking the cartridge ("plastering") and reducing the effective filter life.



***Compare* MICRO-KLEAN with FILTERS WITH HAPHAZARD DISTRIBUTION OF FILTER MEDIA.** Uneven haphazard media density permits fluid to find channels through the filter, and pass solids larger than the minimum filter spacing.



***Now Look* at the advantages offered by MICRO-KLEAN.** See how the fibre density increases toward the discharge side of the MICRO-KLEAN filter cartridge? In effect, every Cuno MICRO-KLEAN cartridge is an infinite multiplicity of screens, ranging from relatively coarse on the outside down to 10 microns in the center. Because of MICRO-KLEAN'S graduated density in depth, particles are entrapped within the entire depth of the filter element, giving the cartridge a much longer effective life. Standard cartridge size is 9¾" long by 2¾" O. D., in densities of 10, 25 and 50 microns.

MICRO-KLEAN gives you

- greater dirt holding capacity
- absolute protection against rupturing or channeling of the cartridge
- longer effective cartridge life

REMEMBER . . . IF YOU CAN PUMP IT, CUNO CAN FILTER IT

M.3.C

CUNO **ENGINEERED FILTRATION**
Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

COMPACT, FULL-FLOW FILTRATION FOR INDUSTRIAL FLUIDS

Fewer Cartridge Changes Necessary with MICRO-KLEAN filters

You don't need a complicated, bulky filter to keep contaminants out of your chemicals, water, lube or fuel oils. Cuno MICRO-KLEAN'S compact construction gives you full-flow filtration in space which would limit ordinary filters to by-pass service.

The high porosity and low pressure drop operation of MICRO-KLEAN filters permit this full-flow service on gravity, low pressure, or suction lines—with no loss in operating efficiency.

Cartridge replacement costs are generally cut in half when MICRO-KLEANS are used. MICRO-KLEAN'S graduated density-in-depth provides much greater capacity for dirt accumulation within the micronic cartridge, giving twice the useful life of an ordinary filter element.

Cuno's exclusive method of felting fibres produces a cartridge of great structural strength, free from channeling or distortion and entirely unaffected by moisture or acids. And changing cartridges can be accomplished in a few seconds—only one nut has to be removed.

Send for Cuno's free filtration analysis form, have one of your engineers fill it out, and mail it to us. We'll let you know exactly what you need for your filtration requirements—without obligation. And take advantage of Cuno's unique "money-back" offer. If MICRO-KLEAN doesn't outperform any filter cartridge you have previously used, we'll send you *double* your money back. Send the coupon today for free MICRO-KLEAN bulletin.

M.3.5

Cuno Engineering Corporation
Dept. 655C South Vine Street, Meriden, Conn.

I'm interested in your "money-back" offer. Please send me your filtration analysis form—and more information on MICRO-KLEAN for

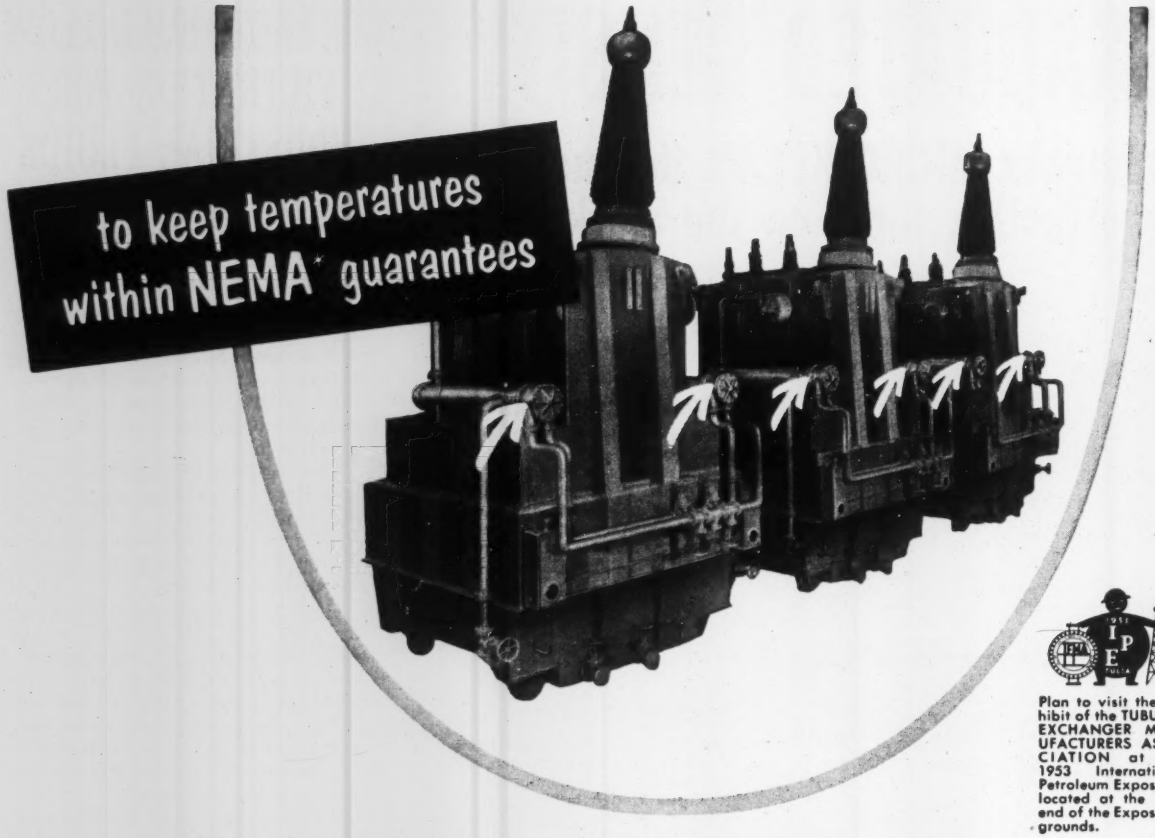
..... (fluid)

Name.....

Company.....

Address.....

City.....Zone....State.....



Plan to visit the exhibit of the TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION at the 1953 International Petroleum Exposition located at the East end of the Exposition grounds.

these Pennsylvania Transformers are cooled with Ross Exchangers

● This bank of three 29,000 Kva, 230,000-volt transformers is typical of many such high voltage power units which Pennsylvania Transformer Company, Canonsburg, Pa. furnishes to major industries and electric utilities.

To prevent transformer oil from reaching excessive temperatures, through heat generated in normal operation, each of these Pennsylvania units is equipped with two Ross Exchangers. Utilizing water as a coolant, their function is to receive the hot oil from the transformer, cool it as required, and return it for its job of maintaining the transformer temperature in accordance with NEMA guarantees.

Why have Pennsylvania's engineers selected Ross Exchangers for these applications? Among other things: "Ross equipment has many excellent features and the Ross organization has a fine background of manufacturing experience...has been very cooperative with us in connection with our heat exchanger problems".

The desire and competence of Ross engineers to consult in the solution of any heat exchange problem ...plus the wide adaptability of Ross fully standardized, pre-engineered designs and sizes, have earned a preference for Ross Exchangers in practically every field of application: engines, compressors, turbines, speed changers, hydraulic machinery and numerous others.

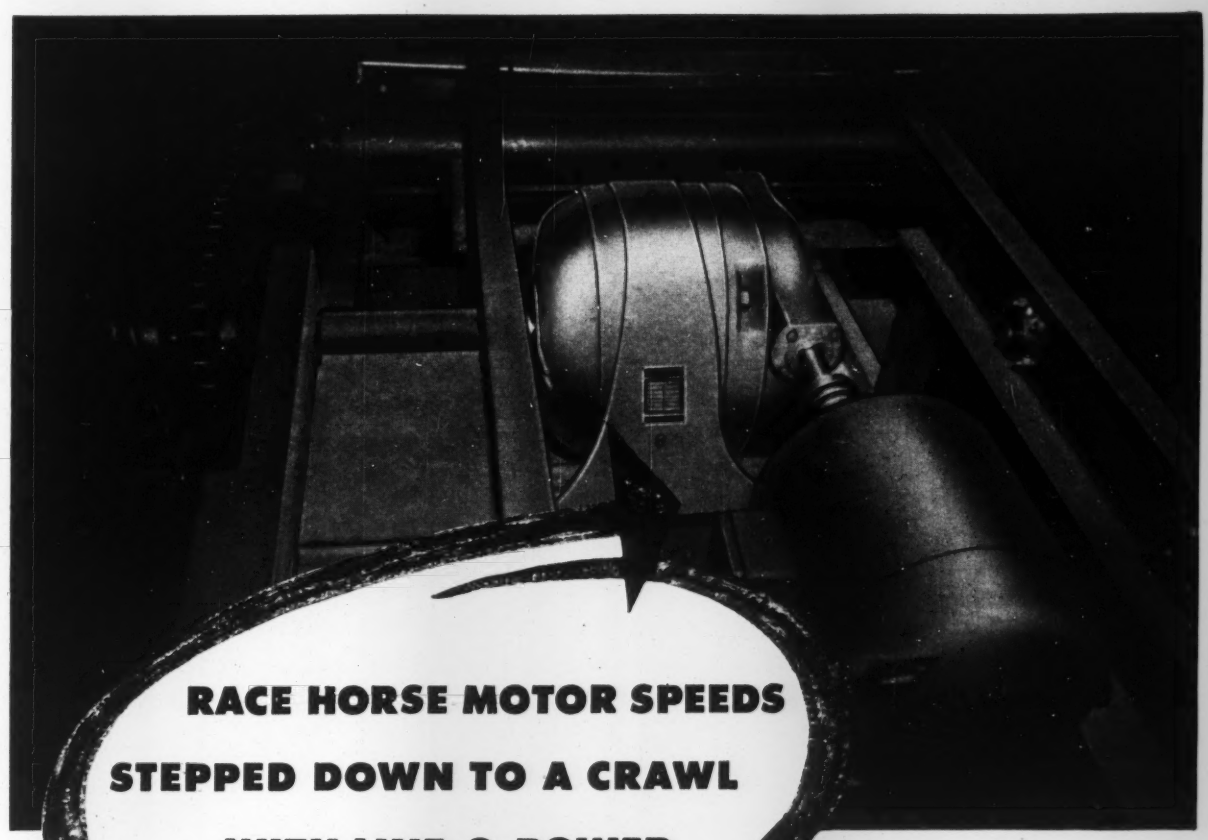
To be familiar with the principal Ross benefits, make sure you have the latest Ross literature. Request Bulletin 2.1K1 for information on the removable tube bundle Type CP Exchangers used on Pennsylvania Transformers, or Bulletin 1.1K5 on all-copper and copper alloy Type BCF units. Write.

KEWANEE-ROSS CORPORATION
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
1448 WEST AVENUE • BUFFALO 13, N. Y.

*National Electrical Manufacturers Association

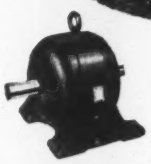
KEWANEE ROSS PRODUCTS

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS



RACE HORSE MOTOR SPEEDS STEPPED DOWN TO A CRAWL WITH LINE-O-POWER

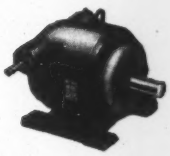
24WL Right angle Line-O-Power Drive on a Chain Conveyor



Double reduction straight line drive

Triple reduction straight line drive

Double reduction vertical drive



Double reduction right angle drive

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
4545 South Western Boulevard • Chicago 9, Illinois

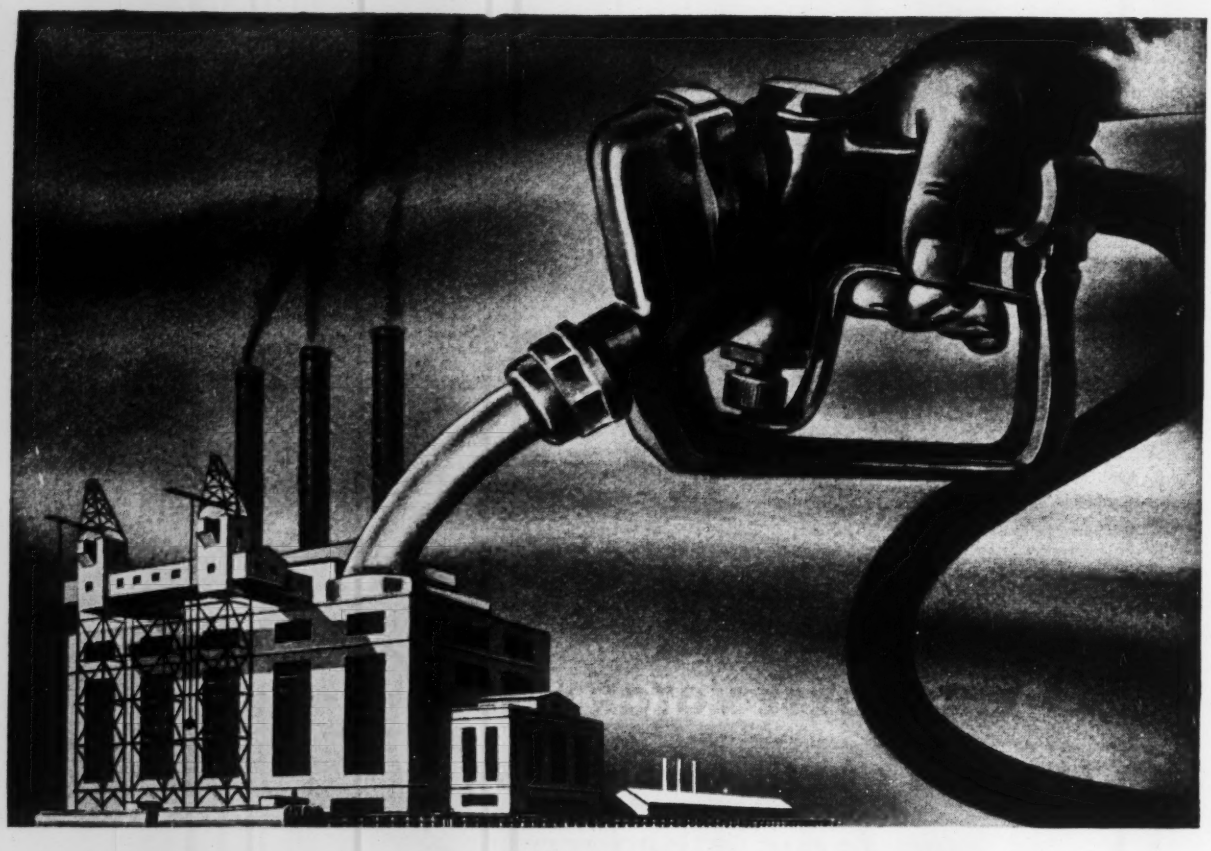
On conveyors or other materials-handling equipment, slow speed is essential. With Line-O-Power Drives, it is possible to transform high motor speeds into almost any desired slow end speed.

Here, for example, is a compact Line-O-Power Drive on a chain conveyor. Low in original cost, it provides economical service day in and day out with minimum attention. These drives have proved their value to industry because of their compact size, sturdy construction and high efficiency.

First reduction is taken through precision worm gearing, second and third reductions through Duti-Rated helical gearing. Duti-Rated Gears have file-hard tooth surfaces with ductile cores that permit heavy loading and yet assure long life. Available for straight line service — for right angle service — or for vertical application.

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. Q, 4545 South Western Boulevard, Chicago 9, Illinois
Please send me Bulletin LPB on Line-O-Power Drive.
I am interested in
☐ Straight line drive ☐ Vertical drive ☐ Right angle drive

Name.....
Company.....
Position.....
Address.....
City.....Zone.....State.....



Refill For Plants That Need More "GO"

Are increased production loads demanding more than your plant can deliver? Here's how a power company we know tackled this problem. The approach used may help you, too.

In their case, demands called for such increases that a new station was needed. And because the area was so densely populated, tight operating economy was as much a "must" as peak productivity.

The boiler designed to meet these needs was built to deliver over a million pounds of steam an hour. In this design, steam scrubbers and cyclone separators literally cleaned the steam to protect superheaters from impurities that cause overheating and corrosion, and to help turbines keep peak efficiency. By making possible greater water level variations, in addition, this boiler permits larger, faster, *safer* load swings, while other new features assure longer life, lower operating costs, more power.

What *approach* assures equipment advances like these? Combined planning by engineering staffs of progressive Equipment Builders working with power engineers and materials suppliers. And for its knowledge of materials—as well as the design freedom, strength and rigidity of its specialty steel plate, heads and shapes—such builders turn to Lukens regularly.

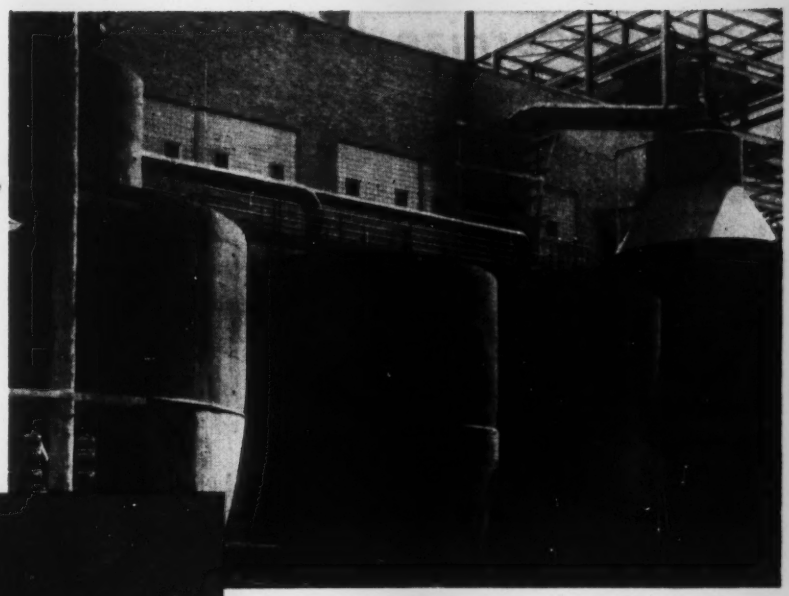
Would you like them to help you? For their names, write us today, explaining your need. Manager, Marketing Service, Lukens Steel Company, 402 Lukens Building, Coatesville, Pa.

LUKENS

World's Leading Producer of

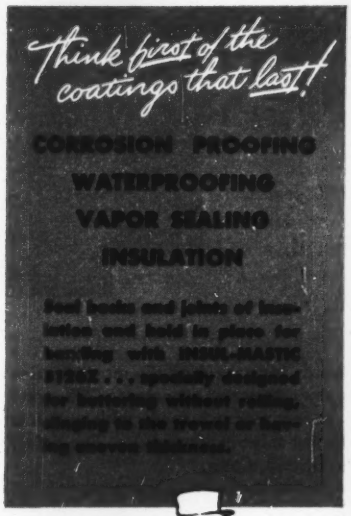
SPECIALTY STEEL PLATE • PLATE SHAPES • HEADS • CLAD STEELS

LUKENS STEEL COMPANY, COATESVILLE, PA.



Only A SUPERIOR COATING ..... INSUL-MASTIC

can keep your thermal insulation dry and protect the tank beneath it



17,000 square feet of tank surface at the Thilmany Pulp and Paper Company, Kaukauna, Wisconsin are protected by INSUL-MASTIC Coatings. INSUL-MASTIC 4010 vaporseals the joints and protects the surface of non-absorbent insulation on the lower half of filtrate tanks. Higher on the tanks, where less insulation is needed, INSUL-MASTIC TYPE "D" both insulates and prevents corrosion.

Where absorbent insulation is used, INSUL-MASTIC 4010 is needed even more because an inferior coating might permit rain or moisture vapor to dampen the insulation. Such a blanket of wet insulation held against your tanks for very long would cause severe corrosion that would mean complete re-insulating.

INSUL-MASTIC prevents such loss since its moisture vapor penetration rate is only .01 . . . practically nil. INSUL-MASTIC has exceptionally long life, due partially to the generous use of Gilsonite and mica. It is extremely resistant to acids and alkalis, a property of Gilsonite. Its temperature range is —40° F. to 300° F., and it is homogenized so that nothing settles in the drum.

Insul-Mastic

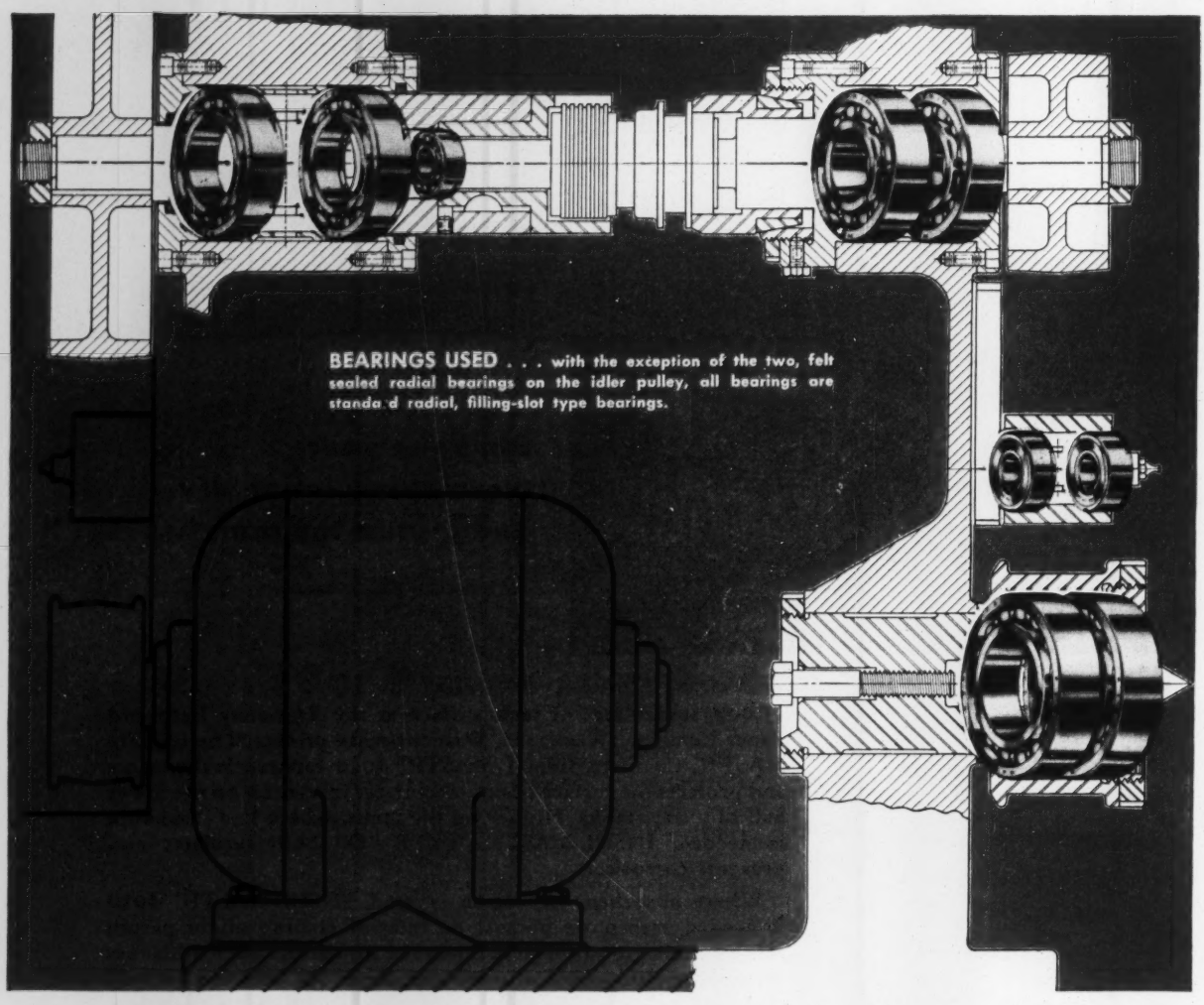
CORPORATION OF AMERICA

Oliver Building • Pittsburgh 22, Pa.

Representatives in Principal Cities

Modernize by Motorizing!

RIGHT ANGLE to a grinder problem


BEARINGS USED . . . with the exception of the two, felt sealed radial bearings on the idler pulley, all bearings are standard radial, filling-slot type bearings.

Here's an idea that may be helpful to you, if you have a problem of motorizing a belt-driven machine. It has already extended the useful service life of a grinding machine by eighteen years . . . and the machine is still in operation.

Building the drive around the motor seemed to be the best way to convert the grinder. This right angle arrangement includes nine Fafnir Ball Bearings . . . all grease lubricated. Speed range of drive, 160 to 720 r.p.m. During World War II, the converted machine was in operation 24 hours a day . . . now it's on two, 8-hour shifts daily. No bearing replacements have been made since the conversion.

Here's another example of the Fafnir "attitude and aptitude" . . . a way of looking at bearing problems from the user's viewpoint, an aptitude for providing the most effective solution based on more than 40 years' experience. Whatever your bearing problem, a few minutes spent with a Fafnir Representative may help you solve it successfully. The Fafnir Bearing Company, New Britain, Conn.

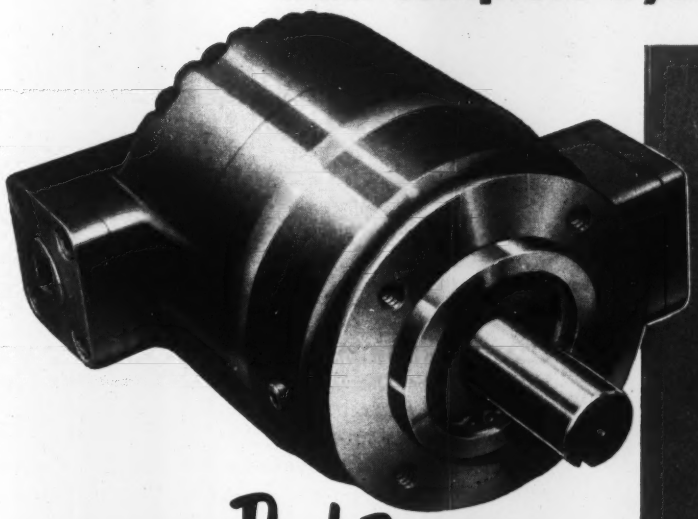
FAFNIR

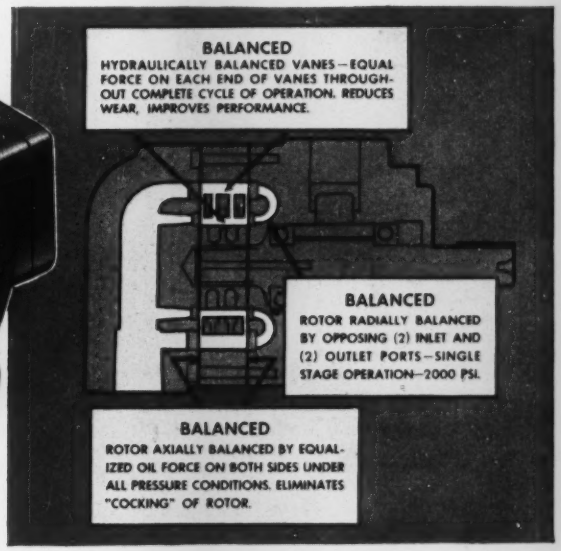
BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

Designed Right

with complete hydraulic balance




BALANCED
HYDRAULICALLY BALANCED VANES—EQUAL FORCE ON EACH END OF VANES THROUGHOUT COMPLETE CYCLE OF OPERATION. REDUCES WEAR, IMPROVES PERFORMANCE.
BALANCED
ROTOR RADIALLY BALANCED BY OPPOSING (2) INLET AND (2) OUTLET PORTS—SINGLE STAGE OPERATION—2000 PSI.
BALANCED
ROTOR AXIALLY BALANCED BY EQUALIZED OIL FORCE ON BOTH SIDES UNDER ALL PRESSURE CONDITIONS. ELIMINATES "COCKING" OF ROTOR.

DENISON *Dual-Purpose* PUMP/MOTOR

PERFORMANCE! Complete hydraulic balance of all operating parts assures longer life, better operation, complete satisfaction. Dual purpose usage increases the value of the Pump/Motor for your every requirement of pumps *or* motors. Pump/Motors operate with equal efficiency in either direction of rotation.

VERSATILITY! Pump/Motors are ready to use, as either pumps or motors, *without alterations of any kind*. Four sizes, each with a choice of cam rings, offer pumping capacities from 2.7 to 70 gpm . . . or motor torque ratings from 13 to 257 pound-inches per 100 psi.

STAMINA! Pump/Motors are highly compact and rugged — built with heavier vanes and heavier rotor, to stand up longer under continuous use *at full 2000 psi.*

SIMPLICITY! Dual-purpose, bi-directional operation makes Denison Pump/Motors your most dependable answer to the widest range of *pump and motor* needs in the 2000 psi range. *Write today for bulletin P-5.*

Denison offers an extensive line of Fluid Motors, Pumps and Controls, for circuit pressures to 5000 psi.

"The Finest Money Can Buy!"

DENISON HydrOILics

The DENISON Engineering Company 1189 Dublin Rd., Columbus 16, Ohio

BETTS MACHINE COMPANY

lights the way to lower costs with—

PARKER DIE CASTINGS

BETTS MACHINE COMPANY, Warren, Pa., is using Parker Die Castings for the *housing* and *hex nut socket* on their Truck Clearance Lights. These lights are pressure tight and "bubble-proof" thanks to Parker's ability to provide leak proof and non-porous die castings. Die castings were also selected because they eliminate machining—to lower production costs. For more than fifty years Parker die castings have been specified by manufacturers in industry . . . automotive, aviation, electrical, business machines and many others. The experience thus gained by Parker can be used to your benefit. Consult with Parker engineers on your next die casting requirements.

and when you think of Die Castings THINK OF

Parker White-Metal Company • 2153 McKinley Ave., Erie, Pa.

PARKER ALUMINUM *and* ZINC *Die Castings*

LADISH

Controlled Quality

PIPE FITTINGS

offer dependability safeguarded by advanced metallurgy

Year after year... in all kinds of service... Ladish Controlled Quality Fittings set new standards of reliability. One reason is the strong reliance on technical progress. Every new facility and advanced technique of modern metallurgy is fully utilized to develop desirable physical properties to maximum limits... while unrelenting test procedures continuously safeguard metallurgical soundness and provide users with authentic data proving the complete dependability of every Ladish Fitting.

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PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

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More equipment rusts out than breaks down. Corrosion is a destructive force that every user of fastenings faces.

Many manufacturers today have found that fastenings by Harper mean longer life for equipment, better appearance, well-satisfied customers—because they resist corrosion.

The H. M. Harper Company is the world's largest exclusive producer of fastenings in brass, naval bronze, silicon bronze, monel, nickel, aluminum and all stainless steels. Over 7,000 items in these metals are carried in stock, bringing the advantage of a single source of supply for all fastenings.

Harper distributors are located in all market areas, and back of these distributors is a complete metallurgical and engineering service, ready to assist in solving any corrosion problem.

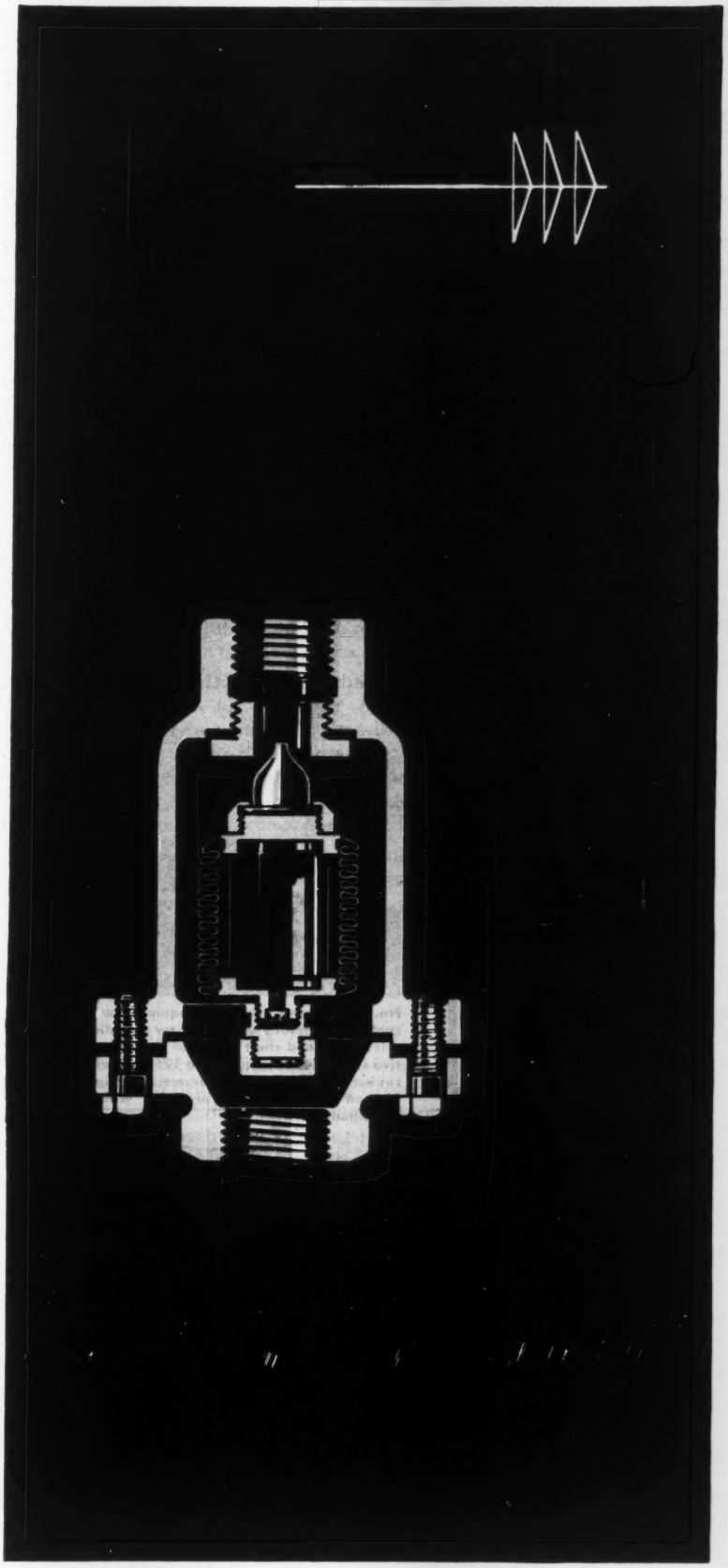
THE H. M. HARPER COMPANY
8243 Lehigh Avenue, Morton Grove, Illinois

HARPER

SPECIALISTS IN FASTENINGS

to solve corrosion problems

SPECIALISTS IN CORROSION RESISTANT FASTENINGS
HARPER
EVERLASTING FASTENINGS
BRASS • SILICON BRONZE • NAVAL BRONZE • MONEL • ALUMINUM • STAINLESS STEEL



AIR is expensive in the wrong place

AIR IN STEAM
spaces cannot supply useful heat. The temperature of a mixture of air and steam is always lower than that of pure steam at the same pressure.

This is equivalent to operating at a lower steam pressure than was intended in the design.

AIR AND OTHER NON-CONDENSIBLES
in the steam space form an insulating film on the condensing surface.

A FILM OF AIR
only 1/1000" thick will offer the same resistance to heat flow as copper 19" thick.

It has been found in practice that 1% of air can reduce heat transfer by as much as 11%.

THE REMOVAL OF AIR
from a piece of steam heated equipment is a sure way of shortening the warming-up period and improving surface temperatures, thus increasing production and reducing fuel consumption.

JUST AS 30 YEARS AGO
we pioneered individual steam trapping based on sound engineering principles, so now we have made available a complete line of Balanced Pressure Thermostatic Air Vents, especially designed for scientific air removal.

LARGE AIR VENTING CAPACITY
When starting up, the large seat orifice is wide open giving free and rapid discharge of initial air. This balanced pressure type allows air which collects during operation to be discharged regardless of operating steam pressure and temperature.

For full information on where and how to apply air vents to speed production and save fuel, write for Bulletin 275-3.

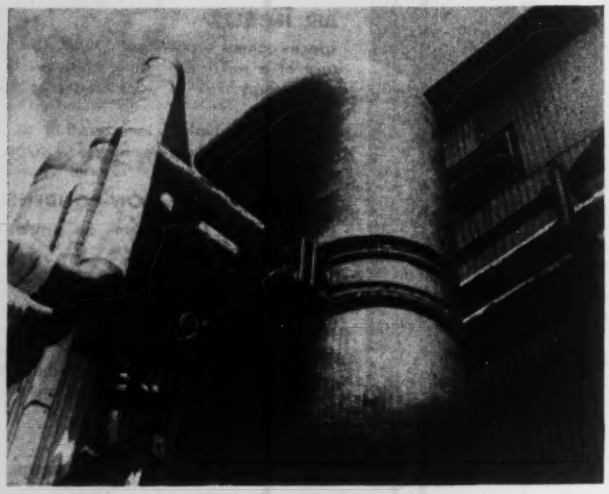
SARCO saves steam
improves product quality and output

SARCO COMPANY, INC.
Empire State Bldg., New York 1, N.Y.
REPRESENTED IN PRINCIPAL CITIES
Sarco Canada Ltd., Toronto 8, Ont.

410

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



R-S VALVES
OPERATE EASILY
Above or Below Floor Level

Because of their comparative light weight and minimum space requirements, R-S Valves are particularly well adapted for installation at considerable heights above the floor level. In such positions they are usually operated manually by chainlever, chainwheel, extended reach rod or controlled automatically.

Where the valve must be installed in an inaccessible position below the floor level, a floor stand is provided. Control is just as quick and uniform as in those installations where the handwheel is mounted directly on the valve shaft.

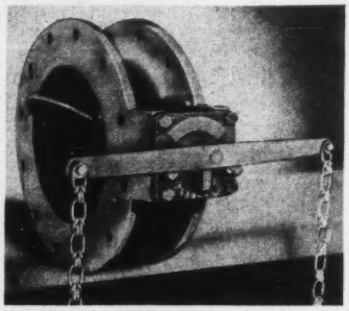
Simplicity of design, the wide range of application and ease of operation indicate the high order of metallurgical and mechanical engineering that is embodied in every R-S Valve.

Consult your local R-S Valve Engineers, or write direct.

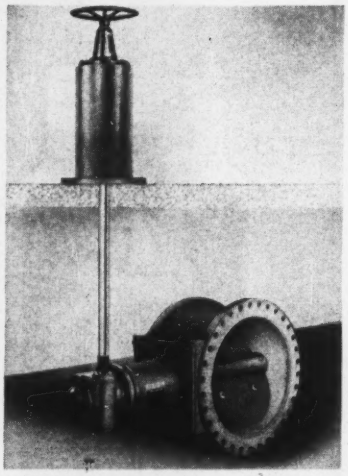
R-S PRODUCTS CORPORATION
4600 Germantown Avenue, Philadelphia 44, Pa.

An S. Morgan Smith Company Subsidiary

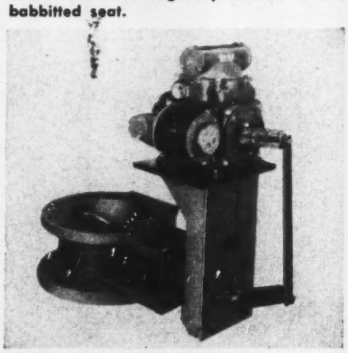
DISTRICT OFFICES IN PRINCIPAL CITIES



No. 688—Heavy duty chainlever valve for quick opening or closing in elevated and inaccessible locations. R-S Valves are used to control and shut-off the volume and pressure of nearly all materials in the temperature range from minus 300° to plus 2000° F. 2 to 2500 psig.



No. 788—Heavy duty valve equipped with rubber seat, totally enclosed gear reduction drive, extended shaft and floor stand. Positive shut-off is obtained up to 125 psig with rubber seated valves and commercially tight shut-off to even higher pressures with a babbitted seat.



No. 839—8-inch heavy duty valve equipped with 125-pound flanges, 18-8 shafts, bronze bushings and a throttling type motor operator for the control of low pressure air.

How to INCREASE BOILER RATINGS with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis **FANMIX** Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

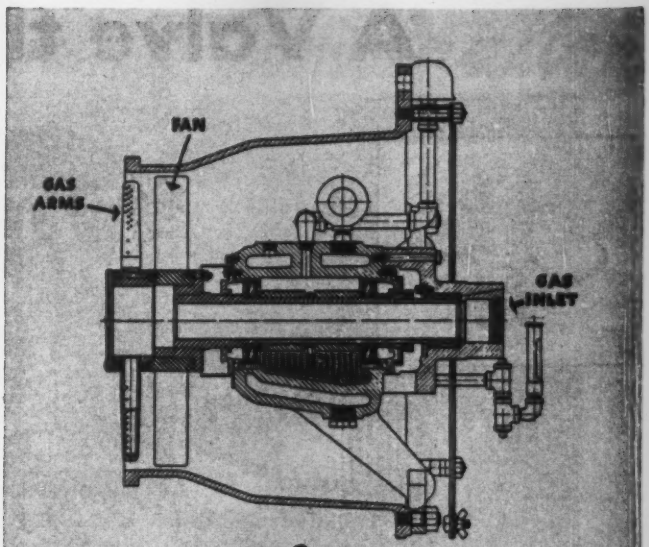
Because **FANMIX** delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

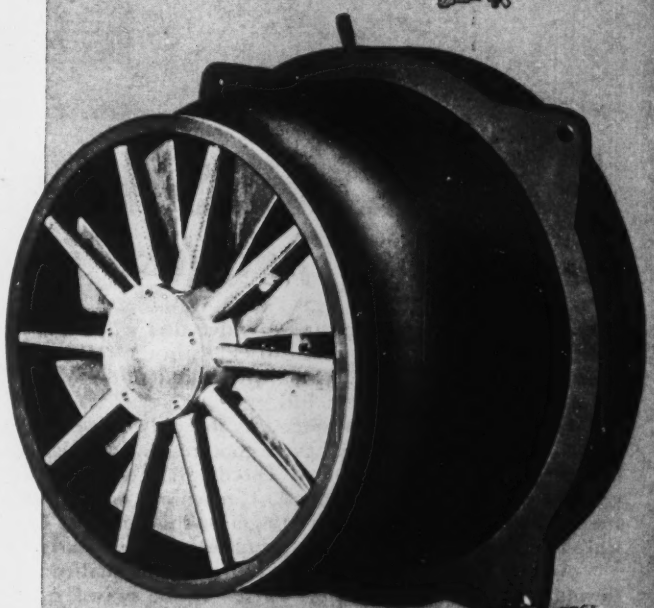
Because **FANMIX** can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a **FANMIX**-fired furnace seldom varies in temperature more than 5% over its entire area.

WRITE FOR ALL THE FACTS

When you see in Bulletin 410–6 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how **FANMIX** creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two **FANMIX** types handle either gas or oil or any combination of both — you'll understand why **FANMIX** Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis **FANMIX** Bulletin 410–6. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, and REFINERY CATALOG.





ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
363 Park Ave., Worcester 2, Mass.
Please send Bulletin 410–6 to:

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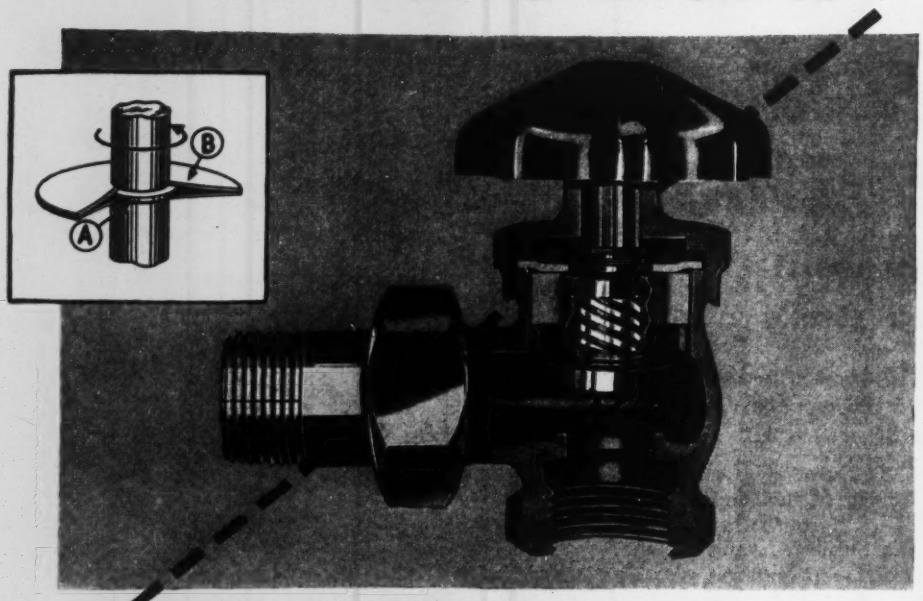
Company .....

Address .....

A Valve that is



PACKLESS in fact

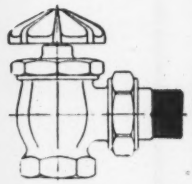
. . . not just packless in name

When the job calls for the kind of valve that will stand up across the years —when it calls for a valve that is packless in the full meaning of the word— then, no matter how far you look, you'll find in the Marsh Packless the only valve that completely fills the bill.

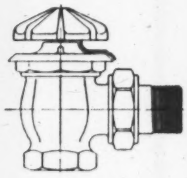
In fact, many users consider this the only valve that is packless in fact as well as in name, and they have a good reason for this. There is a difference between pack less and packless! The diagram tells the story of Marsh truly packless construction. A collar (A) is machined on the valve stem. The stainless spring steel wafers (B) press against this collar to form a tight annular seal This, you see, is a metal-to-metal seal—*permanently* leakproof.

And this better construction is typical of the quality and refinement found throughout the Marsh Packless Valve—in the swivel, self-seating, self-cleaning disc—in the excellent proportioning, machining, workmanship and finish.

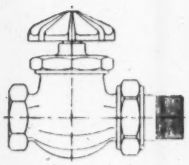
Packed valves can and do "blow out", scalding or burning the operator. This danger is avoided when you use the Marsh Packless. It is a valve you can rely on for any service up to 100 lbs. Furnished in a wide range of patterns including graduated and extended stem types, the Marsh Packless Valve is widely used for steam and hot water heating systems, coffee urns, steam kettles, sterilizers, ovens and similar services. Ask our representative or engineering department for facts.



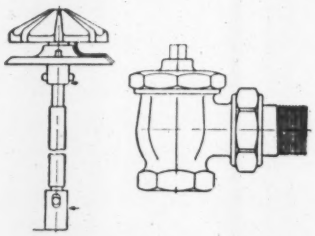
Wheel Angle



Wheel Angle Graduated



Globe



Extension stem

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*

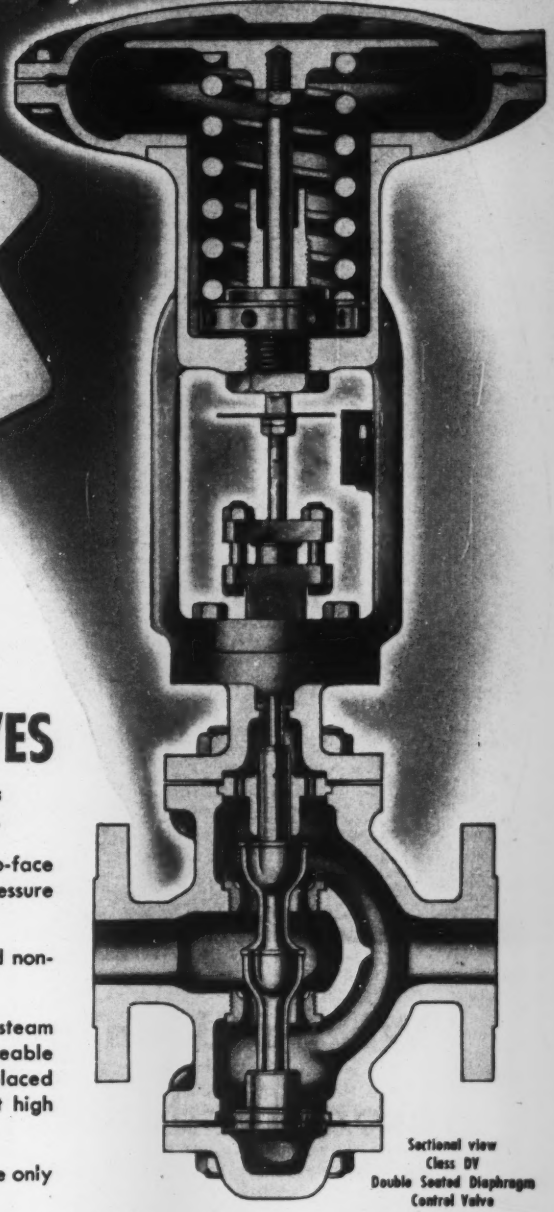
Dept. 29, Skokie, Ill.

MANUFACTURERS OF GAUGES • THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES

MARSH SINCE 1865

Quality Heating Specialties

You've got a Winning Combination



Sectional view
Class DV
Double Seated Diaphragm
Control Valve

...with the New

TRADE
LESLIE
MARK

DOUBLE SEATED DIAPHRAGM CONTROL VALVES

Calling a spade a spade you've got a "royal flush" of features in these new Valves designed for use with control instruments.

Their "Flow-Line" Contoured Bodies have ISA standard face-to-face dimensions and high capacity, low turbulence and minimum body pressure drop characteristics.

A new type, top and bottom guided construction is self-aligning and non-binding regardless of uneveness of bolt tightening.

Standard, integral stellited seating surfaces are recommended for steam service to reduce seat ring thread corrosion. Renewable, interchangeable seat rings also furnished where desired and may be easily replaced without removing valve body from the line. Elaborate grinding at high temperatures is completely eliminated.

With these Valves, you get as *standard equipment*, features heretofore only obtainable in expensive, specially designed valves.

***WRITE FOR* Bulletin 513**

ESTABLISHED 1900
LESLIE CO.
1707

Look for LESLIE REGULATORS under "Valves" or "Regulators" in your classified telephone directory in the following cities where LESLIE factory trained engineers are located:

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Albuquerque, N. M.	Cincinnati, Ohio	Greenville, S. C.	Miami Springs, Fla.	Philadelphia, Pa.	San Francisco, Calif.
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287 Grant Avenue, Lyndhurst, New Jersey

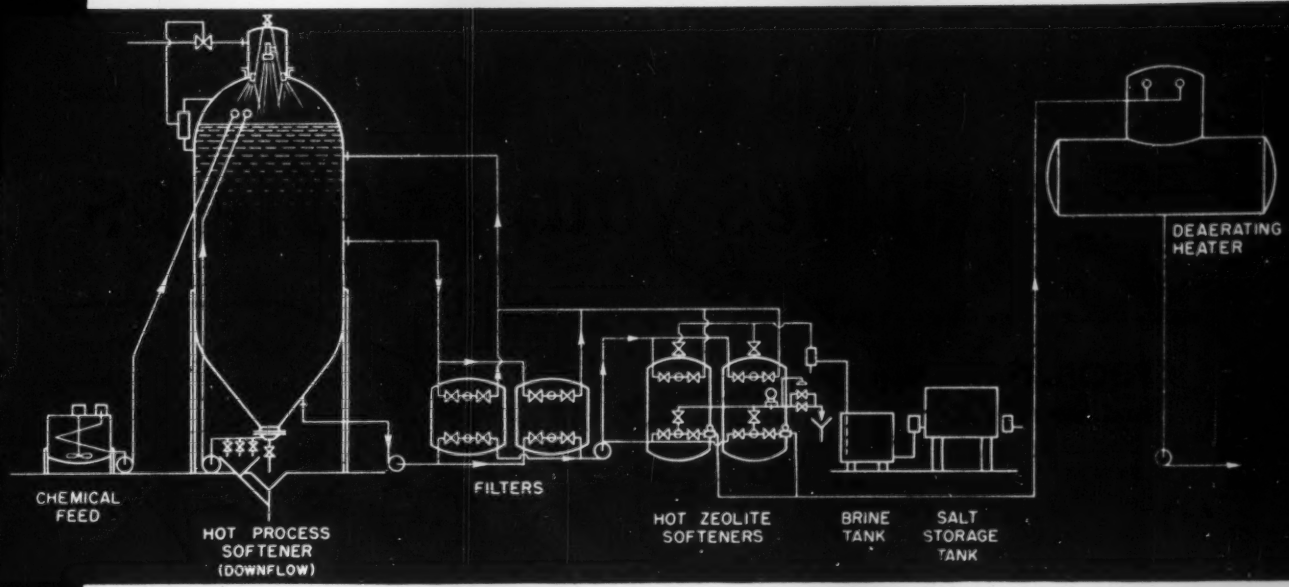
FLOATLESS LEVEL CONTROLS • PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
SELF CLEANING STRAINERS • PUMP GOVERNORS • TEMPERATURE REGULATORS
• AIR HORNS • STEAM WHISTLES

"We need an unbiased water conditioning recommendation. Let's get a proposal from

cochrane

Whether your water conditioning problem is simple or complex, call on Cochrane. Our *full range* of water conditioning equipment assures you *unbiased recommendations* and freedom from makeshift methods.

Cochrane recommendations are based on 90 years of specialized experience in water treatment. And those recommendations are without bias or prejudice—because Cochrane designs and builds *every kind and type* of industrial water treating equipment."—From Cochrane you get the plan and the products to give you water of the quantity and quality you want—with greatest economy. Before you decide on any water conditioning system, be sure to consult Cochrane water engineers.



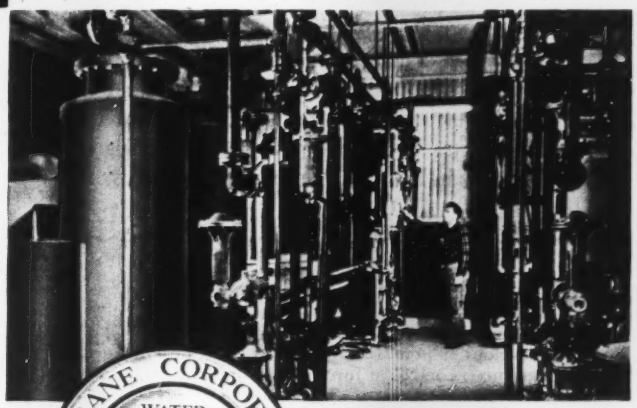
COCHRANE HOT PROCESS ZEOLITE SOFTENER COMBINES EFFICIENCY AND ECONOMY

Combination of a versatile Cochrane Hot Process Softener and a Zeolite second stage provides all the advantages of both systems. It is the most effective and economical means of reducing silica in boiler feedwater preparation. Low total Methyl Orange alkalinities are readily obtained, resulting in lower carbon dioxide in steam generated from this water.

Additional economies and benefits are chemical cost savings obtainable and simplicity of operation. Reason: Inexpensive salt is used for hardness removal instead of more costly soda ash and phosphate. Also, the hardness of the process effluent entering Zeolite units is usually quite low, permitting long Zeolite runs and infrequent regeneration.

LOW COST SOLUTION TO MINERAL SOLIDS PROBLEMS

For economical production of water that is comparable to commercially distilled water in low mineral solids, Cochrane demineralizers are available in multi-bed or mixed bed units of both manual or automatic design for any required capacity. Cochrane demineralizers embody sound design, superior workmanship and conservative ratings to assure maximum operating efficiency and longest life.



Cochrane Automatic Demineralizer producing water of less than 1.0 ppm total dissolved solids in large midwest plant.

Cochrane equipment covers the full range of water conditioning:

HOT PROCESS SOFTENERS
HOT AND COLD ZEOLITE SOFTENERS
DEAERATORS & OPEN HEATERS
DEMINERALIZERS DEALKALIZERS
DEGASIFIERS REACTORS & CLARIFIERS
CONTINUOUS BLOWOFF SYSTEMS
STEAM SPECIALTIES CONDENSATE RETURN SYSTEMS

To give you prompt consultation and service, Cochrane Water Engineers are strategically located in 29 cities throughout the United States. Write for the address of our office nearest you.

COCHRANE CORPORATION
WATER ENGINEERS FOR
90
YEARS
1863 - 1953

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Vibration Engineering that solves your problems

PROBLEM: To locate vibration and measure it

SOLUTION: This sensitive, velocity-type MB Vibration Pickup

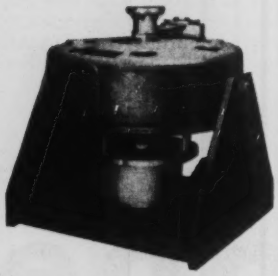
Illustrated here is the MB Type 122 Vibration Pickup developed for jet engine testing. It withstands 500° F.

TO LICK VIBRATION you've got to *locate* it first. That's a job for which the MB Vibration Pickup was developed. It has the sensitivity needed to detect the faintest vibration—the stamina to withstand the strongest.

When fastened to the product, component or structure under test, this pickup faithfully converts vibratory motion into elecrical output. Its signal can be seen and studied on the oscilloscope; or measured by meter such as the direct-reading MB Vibration Meter; or fed to vibration analyzer.

The pickup is usable from 5 to 2000 cps in horizontal or vertical operation. Magnetic damping assures calibration stability. Lightweight moving coil and low-friction pivoting account for the pickup's wide range of serviceability.

Today, this unusual instrument is being found indispensable for accurate vibration detection. It's one more reason why MB is known as headquarters for the answers to vibration problems—including those in shake testing, measurements, vibration isolation and shock mounting. Full details on pickups in Bulletin No. 124-4. Write us.



Double duty vibration exciter

Specification MIL-E-5272 and other vibration testing specifications can be met with the Model C-1 Shaker. It develops 50 pounds of force. An electromagnetic shaker, it features easy, continuous control of force and frequency. It also serves as a calibrator for vibration pickups.

The technique of calibration has been thoroughly presented in MB's booklet entitled "The Calibration of Vibration Pickups to 2000 cps." Send for Booklet C-11-4.

THE MB MANUFACTURING COMPANY, INC.
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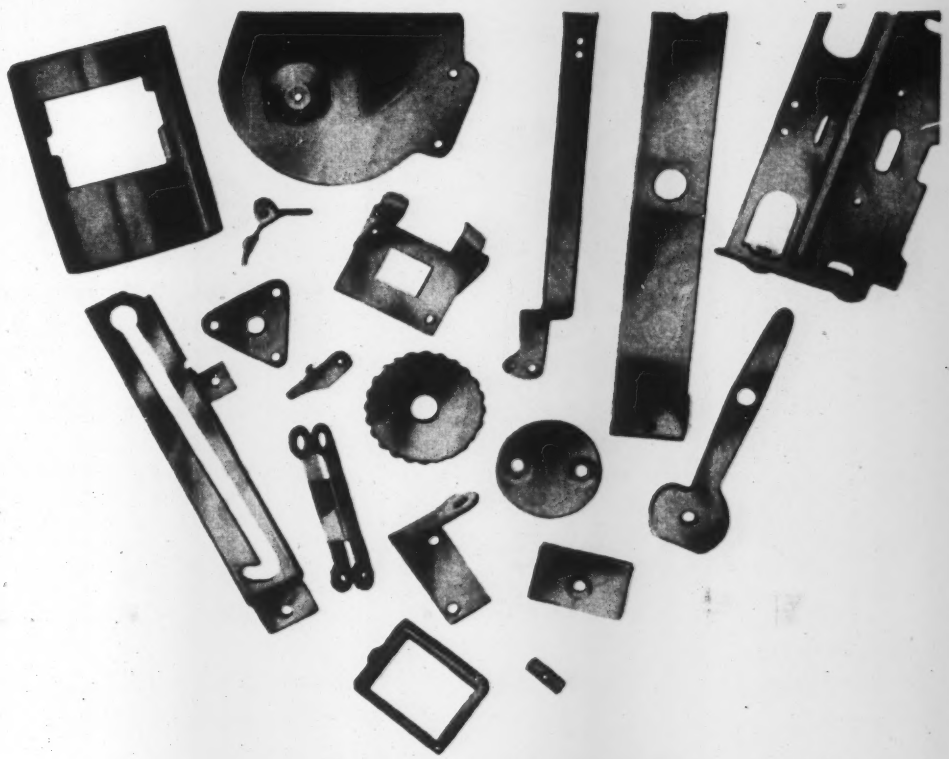

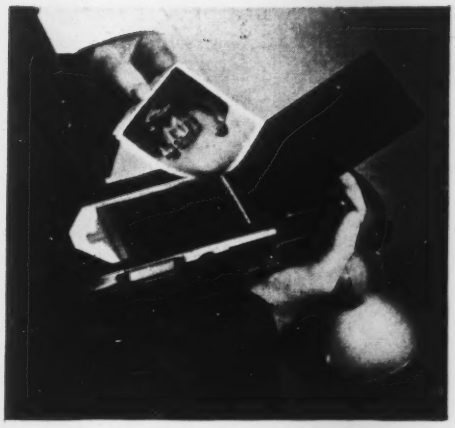

Polaroid's "picture-in-a-minute" camera depends on BRASS

Snap the shutter on the famed Polaroid *Land* camera and a minute later you can have the processed, finished print.

When the Polaroid camera goes into action, a lot of precision-made brass parts go along with it. Each is of the composition, form, temper and finish most suitable for the purpose. Each contributes its share to a longer service life because of its durability, and its resistance to wear, fatigue and corrosion.

Little wonder that so many instrument makers depend on Brass... with so much of it from the mills of The American Brass Company. 5388

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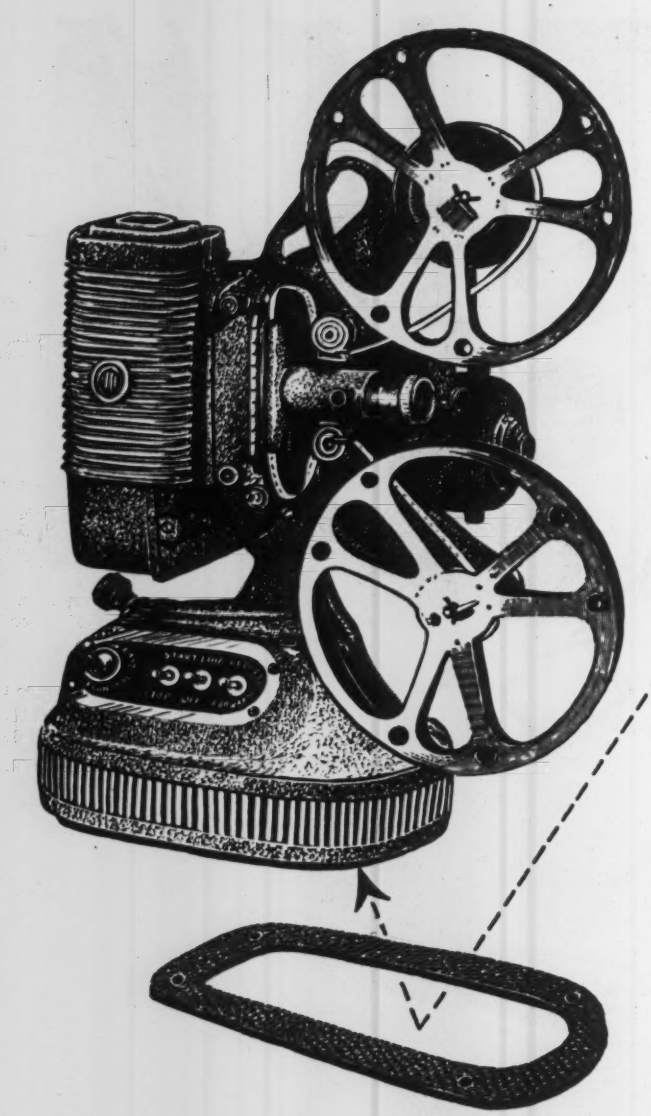

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the Record proves that TURQUOISE holds a Needle Point

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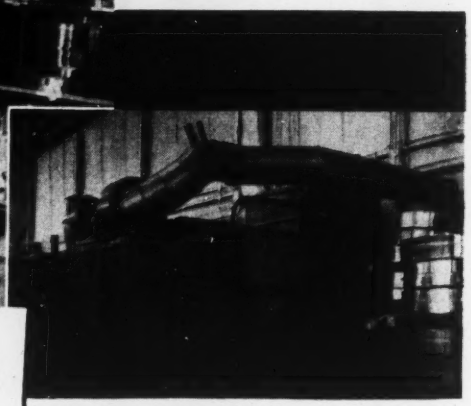
ANOTHER DRY REPORT ON ANOTHER WET YEAR ON KENILWORTH STEEL'S STORAGE OF FINE STEELS

Steel stored in this DRY stockroom—tempered spring steel, feeler gauge and shim steel—needs no grease coating to protect it.



"... the wet summer we had here again verified the value of Lectrodryer equipment. We wish to add, however, that drying is definitely a wintertime advantage, too."

This Lectrodryer* DRYs the air fed to this stockroom at The Kenilworth Steel Company, Kenilworth, New Jersey.

Sizable savings in time and money, credited to this Lectrodryer installation a year ago, have been confirmed during another WET year. Because moisture is taken out of the air which surrounds the fine steels kept here, prompt shipment can be made right from stock; no time-consuming delay while the steel is degreased.

You buyers of steel, who visit The Kenilworth Steel Company's plant, should ask to see this stock room. Perhaps you can use a Lectrodryer to equal advantage, safeguarding materials in stock or being processed against attack by moisture.

Bulletin 222, "Because Moisture Isn't Pink", tells you how others are using Lectrodryers for DRYing air, gases and organic liquids. For a free copy, write Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.

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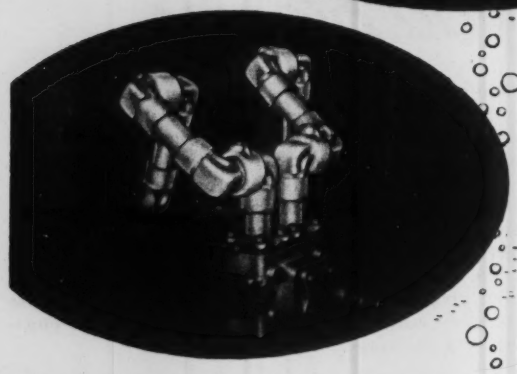
Safety of its people and property, plus increased efficiency and economy of operation, were the chief considerations which turned Johnson Motors to Chiksan Swivel Joints.

Johnson Motors die-casting department, one of the largest in the Middle West — and the largest captive plant in this country — selected Chiksan hydraulic swivel joints when it converted its machines from flammable oils to nonflammable hydraulic fluids.

Forty-eight package die casting machines are operated on a staggered three shift basis, producing more than 400 aluminum alloy die castings ranging from ½ ounce to 11 pounds in size. Hydraulic systems are operated at pressures up to 2000 psi, with average total die forces in the range of 300 to 500 tons. Castings are made at temperatures between 1100° and 1200° F.

Chiksan ball-bearing swivel joints have helped to reduce fluid losses from 40,000 gallons per year to 10,000 gallons. In contrast to former loss of from 1 to 3 gallons in repositioning bolted lines, Chiksan joints permit resetting of table level with virtually no fluid loss. Time consumed in resetting table levels has been reduced from 2 men and 1 hour to one man and 15 minutes of time.

This story is typical of the many ways thousands of manufacturers are using Chiksan ball-bearing swivel joints for greater safety, efficiency, and economy in their operations.



Chiksan ball-bearing swivel joints installed on Lester-Phoenix die-casting machine helped Johnson Motors meet its fluid cost problems.

For Safety, Economy and Efficiency in your die casting department Chiksan has plans and applications worthy of your immediate and serious consideration.

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Ball-Bearing Swivel Joints

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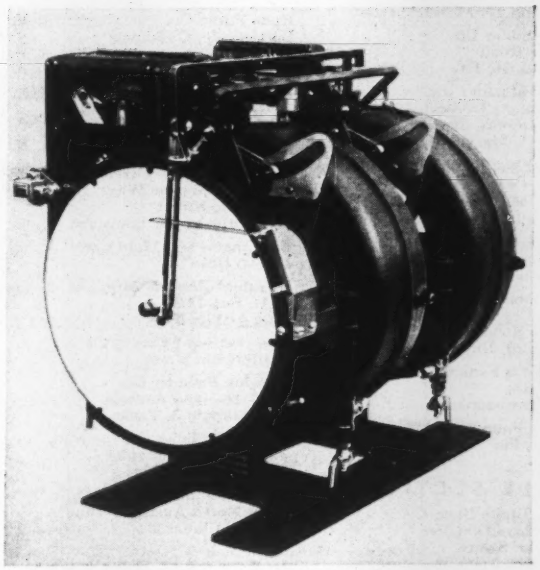

Typical Hagan Ring Balance Dual Flow Meter with two low pressure-low differential rings — for recording and integrating gas flow and recording air flow.

1 **THEY ARE SENSITIVE**—Torque is high, because rings have large cross-sectional area. Friction is low, because of knife edge suspension. The result is exceptionally high torque-to-friction ratio.

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4 **THEY ARE SIMPLE**—There are no stuffing boxes or pressure tight bearings. No dampening devices are used. Level of mercury, or other sealing fluid, is not critical.

5 **THEY ARE RUGGED**—Design and materials produce precision results throughout a long life, requiring a minimum of personal attention, and costly maintenance.

For more detailed information on Hagan Ring Balance Meters, just fill out and mail the coupon or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

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ME-3

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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 75 NUMBER 3

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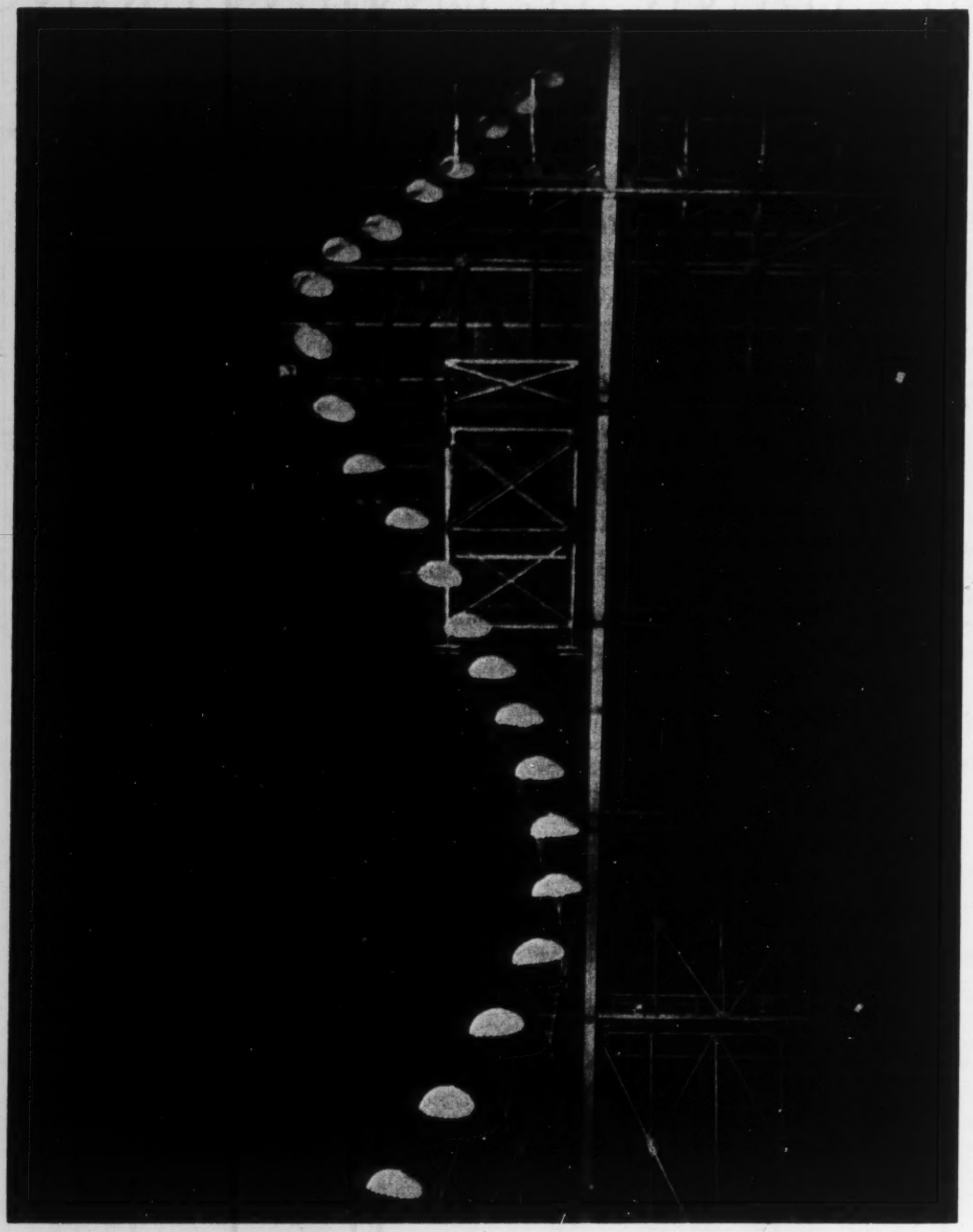

Unique Parachute-Testing Program

*(**Pictured is a photographic study of the free-fall tendencies of parachutes. This series of timed stroboscopic exposures of a falling parachute, were taken at night with the assistance of powerful spotlights and shows the drag and stability characteristics of the parachute as it descends from the ceiling of a huge airship dock to the floor. Research activity is conducted by Goodyear Aircraft Corporation research engineers under terms of a contract with the Equipment Laboratory of the Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. Further details and photographs can be found on pages 236 and 237 of this issue.)***

MECHANICAL ENGINEERING

VOLUME 75
No. 3

MARCH
1953

GEORGE A. STETSON, *Editor*

ASME Research

IT IS unnecessary to convince mechanical engineers of the value of research and development. A goodly number of engineers are themselves engaged in research, many more are working at the task of putting into practice and production the results in goods and services that stem from research, and all live in a world that increasingly enjoys the rising standards of material well being and associated amenities that constitute the fruition of research activities.

Within the last few years the ASME has made an intensive study of its research activities and the organization of its Research Committee, and recently the ASME Council has adopted and put into effect the recommendations stemming from this study.

The report of the Special Review Committee, N. E. Funk, chairman, on which the Council's action was based, contained a number of recommendations and an appendix covering functions and procedures. As reorganized under these recommendations, the Research Committee is designated the Research Executive Committee. It consists of five members and reports to the Board on Technology. An advisory body made up of past chairmen of the Research Committee having an active interest in research is also provided.

Under the Research Executive Committee is a new Research Planning Committee which is responsible for bringing in new projects, keeping existing projects active, and recommending discharge of individual research committees when their activities have ceased. The chairman of the Research Executive Committee is also chairman of the Research Planning Committee. Serving on the planning committee are: the representatives of each individual research or joint research committee, a representative of each professional division having an active interest in a research program, and the research manager who reports to the Secretary of the Society and is a member of the Secretary's staff. Meetings are held three times a year, in April and September, at the Society Headquarters, and at the ASME Annual Meeting, wherever it may be held.

The Headquarters research staff, under a research manager whose principal duty is to provide effective leadership for the entire research program, uncover research projects, outline programs, and obtain necessary financial support, includes also an administrative assistant and two stenographers.

The responsibilities of the Research Executive Committee and the Research Planning Committee are defined as developing and administering ASME-sponsored research and "encouraging capable engineers to receive advanced education to equip them with background necessary to carry on engineering research." The first of these responsibilities necessitates the appointment, as programs are developed, of special and joint research committees to deal with the problems of specific projects. As to the general function of ASME research activities the appendix to the report states:

"ASME research serves all industry by seeking to define and solve broad-interest problems—problems crossing the boundaries of individual companies and industries. The influence of the specific programs goes farther, however, for they catalyze large volumes of independent related researches and individuals. The type of research should be largely restricted to that defined by Dr. Vannevar Bush as 'Background Research,' good illustrations of which are: steam tables; the properties of gases; the properties of metals; effect of temperature on strength of metals; fluid meters; orifice coefficients, etc.

"The ASME should not normally sponsor research in specific commercial developments leading to patentable inventions in any branch of engineering; nor should it promote basic research within a field of science which could best be carried out by other agencies having special facilities and ample financial resources for such work."

In the foregoing statement lies the answer to the natural question: Can ASME, with its meager research funds, make any significant contribution to a nation whose annual expenditures for research are said to be in excess of two billion dollars?

ASME neither owns nor operates any research laboratory, nor are any members of its staff engaged directly in research. The projects it sponsors are of a co-operative nature, are of value to large numbers of its members, and are of a character that might otherwise not be undertaken. The procedure followed may be simply stated. A project is proposed and, if on investigation, it appears to be a proper one for ASME sponsorship, a special research committee is formed, funds are solicited from industrial sources likely to benefit from the results, a contract is signed with a research laboratory, and reports are received and published. Four general groups of projects are recognized: those initiated, financed, and executed under the direct responsibility of the Society; those for which ASME assumes partial responsibility for planning, financing, and execution, the Research Executive Committee co-operating with outside agencies in supervising the activity; those in which ASME, as a public service, merely acts as custodian and dispenser of

funds; and those in which the Society merely lends moral support and assumes no responsibility.

As regards the cost of ASME research, two points should be noted. The funds collected by ASME for a research project cover only a portion of the expense involved. In practically every case contributions in the form of the time of busy men, of some materials and instruments, possibly of laboratory space and personnel may exceed the direct expense met by the solicited funds. Furthermore, the funds collected from industry include ASME administration charges in all but the fourth of the groups of projects named in the foregoing paragraph and in the case of certain projects that have been under way for several years and those aided by grants from The Engineering Foundation. In this manner an attempt is made to reduce to a minimum the financing of research activities by appropriations from the Society's funds.

Because of the broad and basic nature of the research projects sponsored by ASME, the benefits which accrue to members of the Society and to the engineering profession are real and widespread. Every teacher and student of mechanical engineering depends on the work done by some ASME research committee. Everyone who uses steam tables has to thank the Society for the part it played in extending the reliable data on the properties of steam into the upper ranges of pressure and temperature. Every designer and operator of equipment subjected to high pressures and temperatures, every power-plant operator, everyone who uses flowmeters, owes a debt to the Society. Every writer of textbooks and every compiler of handbooks in a number of fields draws on the results of ASME research committees. As time goes on, the extent of this debt increases. Few members ever stop to consider this debt, which is only one of several owed to their Society. But those who do experience a sense of pride and satisfaction in belonging to a Society that has served them and their profession so well.

Martin M. Foss

ENGINEERS the world over, and particularly those who were educated and have practiced in this country, have reason to pay tribute to Martin M. Foss, cofounder and president, 1927–1944, of the McGraw-Hill Book Company, who died on Jan. 13, 1953, in his seventy-fifth year. Members of the Founder Societies have a special reason to remember him because it was he who brought into being, in co-operation with those societies and the Engineering Societies Library, the Engineering Societies Monographs Series, to which attention was directed in this space in November, 1951. The technical monographs published in this series over a period spanning nearly a quarter of a century are not numerous but of high quality and the authors and coauthors include such well-known names of specialists in engineering as Nadai, Wahl, Timoshenko, Goodier, Bakhmeteff, Tietjens, Baylis, Rouse, and Rich.

Martin Foss, a publisher of great vision, acumen, and energy, was a native of Maine and a graduate of Harvard. His career as a publisher began in 1901 when he became associated with the Baker and Taylor Company. At that time two great publishers of technical magazines, James H. McGraw, Sr., and John A. Hill, had organized book-publishing operations that were natural developments of the opportunities offered by their magazine activities. In 1907 Mr. Foss became manager of the book department of the Hill Publishing Company. In this post he and his opposite member in the McGraw organization, Edward Caldwell, were influential in persuading Mr. McGraw and Mr. Hill in 1909 to combine their book-publishing ventures in the McGraw-Hill Book Company. Mr. Foss served the new organization as secretary. From 1917 to 1927 he served as vice-president and general manager and from 1927 until his retirement in 1944, as president of the Book Company.

After the death of Mr. Hill in 1916, a consolidation of the technical magazines published by the McGraw and Hill companies was consummated in the organization known as the McGraw-Hill Publishing Company. Meanwhile the vision and sound business judgment of Mr. Foss and his colleagues, under the guiding genius of James H. McGraw, Sr., were at work expanding the fields served by the Book Company from that of engineering handbooks and textbooks into the areas of science on the one hand, and business and general subjects on the other.

Close and cordial relationships have always existed between ASME and the publishers of technical books and magazines. Members of the staffs of such organizations have been prominent in ASME affairs. William H. Wiley, of John Wiley and Sons, was ASME Treasurer from 1884 to 1925. Fred R. Low, former editor of *Power*, gave long and devoted service to the Power Test Code Committee and was President of the Society in 1924. Fred H. Colvin, beloved and veteran editor of *American Machinist*, was awarded the Worcester Reed Warner Medal in 1942. The publication and professional-division activities of the Society have seldom been without the helpful counsel of editors of technical publications. Publishers of engineering books have donated hundreds of volumes to the Engineering Societies Library and to MECHANICAL ENGINEERING and the *Journal of Applied Mechanics* for review.

It would be impossible to estimate the number of members of ASME who have used the textbooks of these companies during their college years and in the practice of their profession, or the number of members who have written books and articles for them and the technical press, or the number of editors who have been members of ASME or served on its numerous committees. From the days of Jackson Bailey, editor of *American Machinist*, in whose office the idea of organizing the Society was explored in 1880, until the present, publishers and editors of engineering books and magazines have made numberless and important contributions to the Society and its members. Hence this brief tribute to Martin Foss is also a tribute to all of his colleagues and men of his type and manner of thinking who render valued service to the advancement of the engineering profession in the field of publications.

World's Largest FORGING PRESS

Design and Analysis of a 50,000-Ton-Capacity Machine

By F. T. MORRISON[1] and R. G. STURM[2]

THE production of large forgings for use in aircraft construction and of large extruded shapes has become a primary goal of the industrial mobilization program for strengthening our Air Force. The need for large forgings and extruded shapes is derived from the need for stronger, lighter, and fewer components in the construction of conventional and newer types of aircraft which already have become extremely complex, costly, and time-consuming in their manufacture. The first step in this program has been the design and construction of forging and extrusion presses to meet these needs. The program calls for several closed die-forging presses ranging in capacity up to 50,000 tons.

In designing forging presses which are larger than ever have been built, it was necessary to review the criteria of design in order, (1) to insure that the presses can be made with existing manufacturing facilities, (2) to make the equipment safe in its operation, (3) to produce forgings with the desired dimensional accuracy, (4) not to tax the transportation facilities in transporting the press components from the shop to the erection site. A review of these criteria resulted in a completely new concept of design which was evolved by the company with which the authors are associated.

A 50,000-TON FORGING PRESS

This new design, shown in Fig. 1, is a 50,000-ton-capacity pull-down press with nine hydraulic cylinders and six tie rods or columns. The over-all height of the press is approximately 110 ft. All of the structure below the lower platen of the press is submerged below the floor or working level making the superstructure at its highest point approximately 60 ft above floor level. The total weight of the press is approximately 10,000 tons; the moving parts weigh 6000 tons.

The main structural members of this press are composed of composite and transverse forged-steel slabs which when assembled and restrained by shrunk tie rods provide for extremely rigid upper and lower platens, thus minimizing press-platen deflections.

The main tie rods or columns of this press are not of the conventional cylindrical type. Each of the six main tie rods is rectangular in cross section and is made up in three laminations which are approximately 110 ft long. Since each of the six main tie rods weighs in the neighborhood of 600,000 lb, it is impossible to obtain them in a single steel forging since the latter requires ingots of steel which are far heavier than the largest ingot which can be made with present know-how. By making each main tie rod in three individual rectangular sections, sounder forgings are obtained, and the problems of fabrication, machining, and handling are much improved.

The press is powered by nine hydraulic cylinders which are disposed to balance the hydraulic forces, reduce the bending

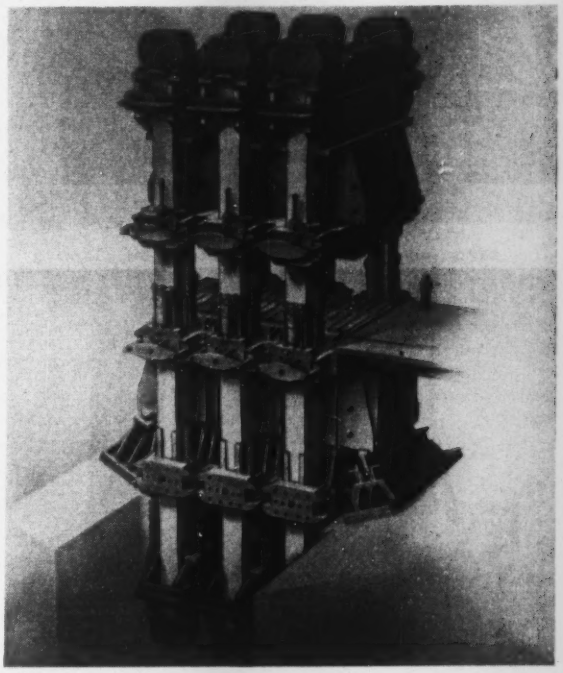

FIG. 1 50,000-TON-CAPACITY CLOSED DIE-FORGING PRESS

effects on the structural members of the press, and put them in almost pure compression. The forces are transmitted through a gridwork of plate beams to the lower platen of the press, and through the main tie rods to the upper entablature. In contradistinction to conventional presses, the entire upper entablature of this press moves with the upper platen. As many as six different pressure stages can be obtained by using various combinations of the nine hydraulic cylinders and by selecting either rated hydraulic pressure of the accumulator system or by using an intensifier arrangement.

To protect the press against excessive eccentric loads which would cause damage to either the main tie rods or to the press structure itself, a unique type of hydraulic force-compensating system has been devised. Its action is entirely automatic and the degree of load compensation is a function of the rotational deflection of the upper entablature of the press when it is subjected to an eccentric loading. The eccentric load compensating system is designed to compensate for a compound eccentricity, co-ordinate to the center of the press platens. In addition to the compensating system, an automatic strain-gage protective system has been incorporated into the press. The strain gages are mounted permanently on the main tie rods of the press. When preselected values of strain in the tie rods are exceeded, the hydraulic system is unloaded automatically thus preventing damage to the press.

In designing a machine whose components are as enormous

[1] Chief Stress Analyst, Loewy Construction Company, New York, N. Y.

[2] Director, Auburn Research Foundation, Auburn, Ala. Mem. ASME.

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FIGS. 2, 3, AND 4 PHOTOELASTIC STUDIES OF TIE-ROD HEAD

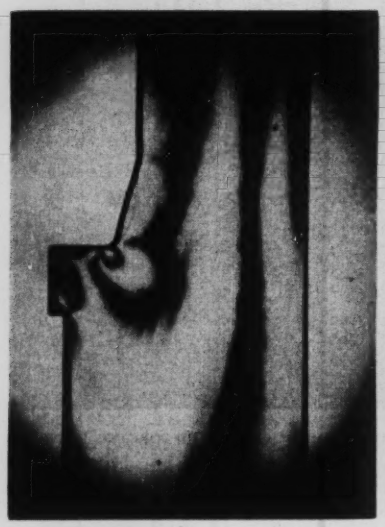

FIG. 5 RADIAL SLICE—PHOTOELASTIC STUDY OF HYDRAULIC CYLINDER

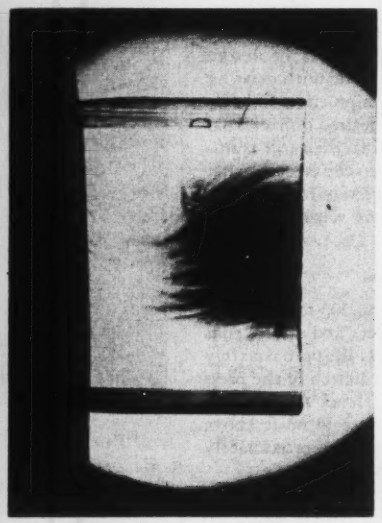

FIG. 6 TANGENTIAL SLICE—PHOTOELASTIC STUDY OF HYDRAULIC CYLINDER

FIG. 7 AXIAL SLICE—PHOTOELASTIC STUDY OF HYDRAULIC CYLINDER

and massive as those required for a 50,000-ton-capacity die-forging press, not all design problems are capable of solution on the drafting board. And if they were, a confirmation of such results is desired in order to avoid costly repair of parts and replacements once the machine is put into operation. The determination of the best shape for load-transmitting members to keep to a minimum the effects of stress concentration cannot be calculated readily. Furthermore, the analysis of very complex shapes cannot be approached in a straightforward manner by pure analytical computation. Hence resort has been made to experimental methods which include two- and three-dimensional photoelastic studies as well as the testing of scale models.

DETAILS OF COMPONENTS

The following components of the 50,000-ton-capacity closed die-forging press were subjected to investigation by experimental methods.

Main Tie Rods (Columns). Failures in round press columns with threaded anchor nuts are not infrequent. The failure invariably occurs at the root of the first thread immediately adjacent the nut-bearing surface. A study of such failures reveals that large stress concentrations exist at the root of the thread. In addition to large stress concentrations, it has been found that a nonuniform force loading exists around the shoulder of the nut which is a result of bending and shear deflections of the crossheads, giving rise to higher than average stresses at the root of the thread.

The anchors of the rectangular columns used in the 50,000-ton-capacity press do not utilize threaded connections. Anchoring is achieved by means of enlarged sections integrally forged with the main column or tie-rod section. The enlarged sections bear on half-cylindrical segments which transmit the load to the crosshead beams. The optimum configuration of the tie-rod head was determined by photoelastic investigation. Figs. 2, 3, and 4 show the photoelastic patterns of three different types of tie-rod heads. Eleven configurations were investigated by photoelasticity.

Main Hydraulic Cylinders. The main hydraulic cylinders of the 50,000-ton-capacity forging press are forged-steel cylinders

which are designed to receive 47³/₄-in-diam rams. The hydraulic force is transmitted from the cylinders to the press structure through flanges which are forged integrally on the open end of the cylinders. The physical transition from the cylinder wall to the flange is a location where stress concentration is known to exist. Its magnitude depends entirely on the design features of this transition. Since failures in hydraulic cylinders have occurred at the junction of the flange and cylinder wall, a thorough investigation of the design used in this press was made.

Three-dimensional photoelasticity was the method used in this investigation. The results confirmed the present design showing relatively low stress concentrations. Fig. 5 shows the photoelastic pattern of a radial slice taken from a three-dimensional model which was loaded in the same manner as the prototype cylinder. Figs. 6 and 7 represent, respectively, the photoelastic patterns in the tangential and axial slices which were interpreted together with the pattern shown in Fig. 5.

Cylinder Holding Ring. A steel casting is employed to transmit the hydraulic effort from the main cylinder flange to the parallel structural beams of the press. Because of space limitations this casting is somewhat complex in its configuration. The determination of adequacy of design by analytical methods must be based on many simplifying assumptions. Therefore the investigation of the cylinder holding ring was accomplished by experimental model testing.

Cast-aluminum models, 1/6 scale, were employed. The first three models were made from aluminum alloy T-356 because of its excellent casting properties. These models were first tested with brittle lacquer coatings to determine the direction of the principal stresses and finally were tested with SR-4 strain gages. Two of the T-356 alloy models were loaded to destruction, the first failing at a load of 400,000 lb and the second at a load of 470,000 lb, the latter being 1½ times the equivalent design load for the prototype. However, it was determined that the elongation property of the T-356 alloy was much lower than that to be expected for the cast steel in the prototype. Failures of the T-356 alloy models were definitely brittle.

It then was decided to make the model of an aluminum alloy whose elongation properties were closer to those of the steel to be used in the prototype. Models were cast in aluminum 220 T-4. One of these high-strength-alloy models was tested in the elastic range by observing strain-gage readings during loading. The model was brought to full load in increments. It sustained a load of 907,000 lb before failure. This is about 3 times the equivalent design load for the cast-steel prototype. Fig. 8 shows the test setup for this model in a 3,000,000-lb testing machine. Figs. 9 and 10 show the fractured model which closely resembles the fractures in previous tests.

By performing these tests nothing is left to chance; and the adequacy of design was proved.

PRESS STABILITY

All presses during normal operation are subject to lateral crosshead deflections and oscillations. As mentioned previously, the 50,000-ton-capacity closed die-forging press is a "pulldown" press. The cylinders are located below the lower press bed and the upper entablature and upper platen are pulled down against the work in the dies between the press platens. To be certain that a stable design had been achieved, it was necessary thoroughly to investigate the ramifications of the general press stability. The first phase was to consider the static resistance to the maximum possible eccentric loads in the press. The eccentric load in this press is resisted by the flexural

(*Continued on page 204*)

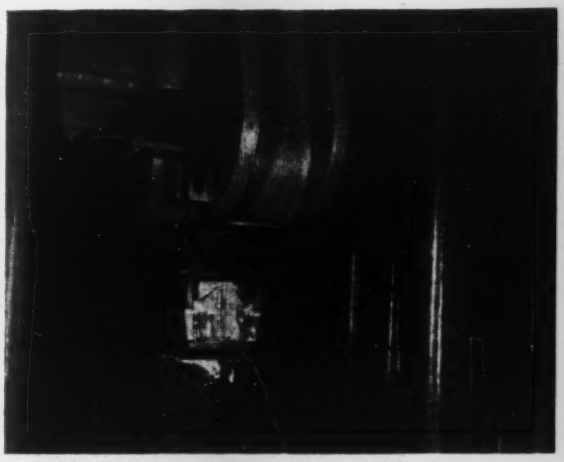

FIG. 8 MODEL TEST SETUP OF CYLINDER CONTAINER

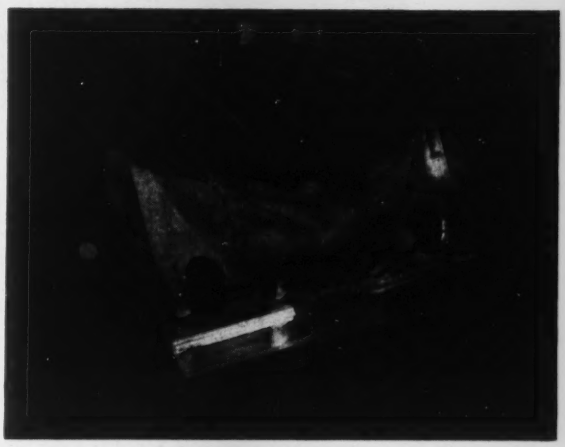

FIG. 9 LOAD FAILURE OF CYLINDER-CONTAINER MODEL

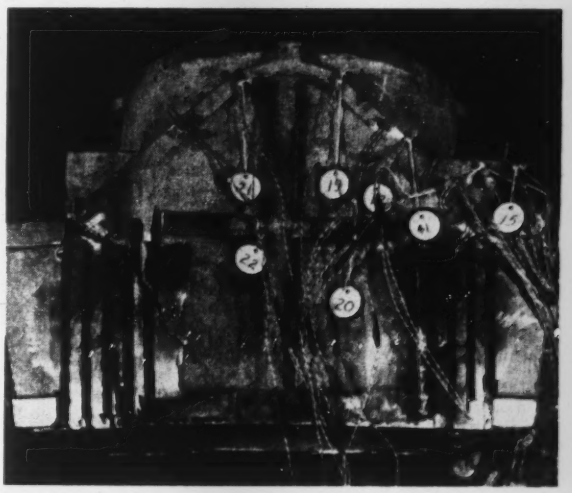

FIG. 10 LOAD FAILURE OF CYLINDER-CONTAINER MODEL

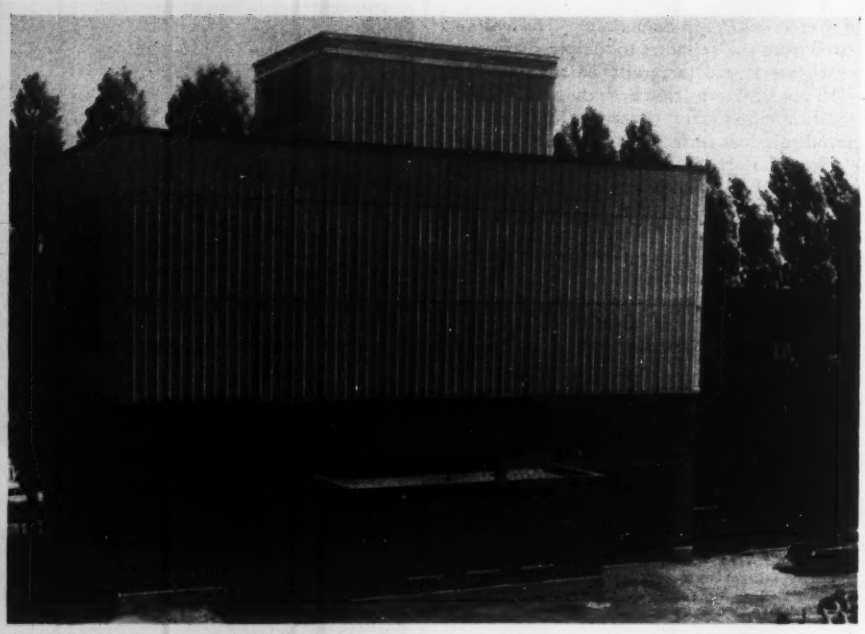

FIG. 1 THE DOMINION ENGINEERING WORKS CAVITATION LABORATORY FOR TURBINE TESTING

CAVITATION LABORATORY *for* HYDRAULIC TURBINES

Details of Test Equipment and Calibration Procedure

By HANS ULMANN[1] AND R. S. SPROULE[2]

DOMINION ENGINEERING WORKS, MONTREAL, CANADA

INTRODUCTION

CAVITATION in hydraulic turbines usually affects the performance adversely from the point of view of efficiency and power and the life of turbine parts. It also makes the prediction of power and efficiency unreliable. Cavitation damage is probably responsible for more time out for repairs than all other mechanical difficulties. It appears to be caused by the formation and collapse of cavities in the flow along the boundaries in regions of low pressure. It can be demonstrated by mathematical analysis that the velocity of the water entering such a cavity collapsing to zero volume is great enough to produce water-hammer pressures higher than the fatigue strength of materials ordinarily used for turbine construction. High-speed photography has been used to substantiate this theory.[3]

A great deal of interesting research is being done in scientific laboratories to help us to understand the phenomenon of cavitation so that we may better combat it. Scientists and manufacturers are also engaged in research to find materials which will stand up well to the action of cavitation. The laboratory, Fig. 1, described in this paper covers another side of the research; namely, it is used to develop turbine designs having better cavitation characteristics and to set limits of exploitation which will hold cavitation damage within economical limits. The procedure is to make comparative tests on different turbine designs and to check them against field experience.

SCOPE OF EQUIPMENT AND MODEL SIZE

The cavitation laboratory of the authors' company is used for testing a wide range of turbine designs, from Francis turbines with specific speeds as low as 18 under heads up to 80 ft, to propeller turbines with specific speeds as high as 180, under heads as low as 25 ft.

About 27 years ago, when the importance of cavitation on the performance of propeller turbines was becoming apparent, the authors' company and the Shawinigan Water and Power Company jointly operated a cavitation laboratory using a

[1] Chief Engineer, Industrial Division. Mem. ASM.E.

[2] Assistant Manager—Sales, Hydraulic Division.

[3] "Laboratory Investigation of the Mechanism of Cavitation," by R. T. Knapp and A. Hollander, Trans. ASME, vol. 70, 1948, pp. 419–431.

Contributed by the Hydraulic Division and presented at the Annual Meeting, New York, N. Y., November 30-December 5, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

natural head of water at Shawinigan Falls. Many useful tests were obtained before the laboratory had to be removed in 1947, to make room for the No. 3 powerhouse. In 1932 an open-flume test stand for efficiency testing was built at the Dominion works. Both of these installations used 16-in. model runners, so when the new cavitation laboratory was designed it was decided to make the best use of model runners and data by maintaining the same size. In this way existing models can be tested for cavitation and the results interpreted in terms of the known performance of existing plants. The extra cost of making a cavitation laboratory to handle large models is also justified by the relative ease of making good models and the greater accuracy of tests, which is important for measuring the small performance changes resulting from small changes in the design.

Circuit. Fig. 2 is a flow diagram of the cavitation laboratory.

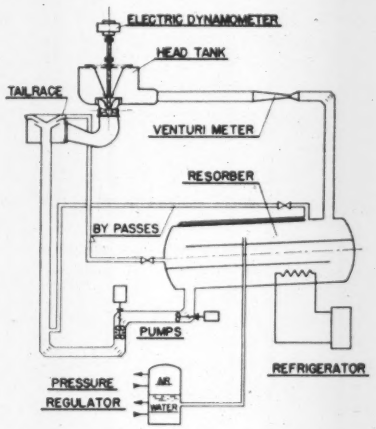

FIG. 2 SCHEMATIC FLOW DIAGRAM

The principal items of equipment, shown diagrammatically, are described in the following:

To permit changing the pressure at the tailrace, the equipment is arranged in a closed circuit. The pumps provide sufficient pressure to run the turbine and make up friction and velocity losses. If the head on the turbine is kept constant, the cavitation factor can be varied by varying the pressure level in the system. This is done by changing the pressure equally in all parts of the circuit, by means of the pressure regulator.

The object of the installation is to obtain accurate test results as economically as possible, so there are facilities for quick change-over of models.

Pumps. The widely varying heads and quantities required by different model turbines are obtained by using adjustable-blade-propeller pumps. The propeller pumps have relatively steep head-quantity characteristics, which is a desirable feature for stability of the flow in the circuit. To obtain as much as 80 ft head on Francis turbines of low specific speed, three pump impellers are required operating in series, and only two are required for low-head propeller turbines. Therefore two impellers are combined to form a two-stage pumping unit, which is in operation for all tests, while a third impeller in a second single-stage pump operates as a booster when higher pressures are required.

Favorable pump performance is maintained for the relatively low discharge requirements of low-specific-speed turbines by regulating valves in the by-pass lines, which are used to maintain a reasonable flow through the pumps.

To maintain equilibrium and prevent surging in the system it is desirable to hold the speed of both the turbine and the pumps as constant as possible. This is achieved by employing synchronous motors for driving the pumps, and a well-governed brake on the turbine shaft. The two-stage pump is driven by a 200-hp motor and the single-stage pump by a 100-hp motor, both at 900 rpm. All impellers are $21\frac{1}{2}$ in. diam. Satisfactory operation of the pumps requires identical blade pitch for all three impellers.

Resorber. Cavitation phenomena may be influenced by the amount of air in solution in the water. Therefore it is desirable to maintain the air content of the water constant during any test. To do this a "resorber" is used.[4] This is a large tank where the water in the system is maintained under pressure for a considerable time, so that air which comes out of solution under the low-pressure conditions of the turbine runner and draft tube may be redissolved. Another function of the resorber is to provide a large reservoir where pressure waves originating in the pumps and fittings are damped out. The resorber is placed as low as practical so that the pressure is relatively high.

The resorber is a cylindrical vessel about 40 ft long and 11 ft diam. At a flow of 35 cfs it takes about 2 min for a complete change of water.

The resorber cannot be made large enough to redissolve as much air as normally exists in the water supply, so it has been found necessary to install air blowoff valves at strategic points. However, once the surplus air has been discharged the resorber maintains equilibrium in the system, and the air content during tests is generally the same throughout any test and comparable to other tests.

Venturi Meter. The main outlet from the resorber goes through a Venturi meter to the turbine-head tank. The accuracy of the tests depends on the accuracy of the flow measurement so elaborate precautions were taken with the meter construction and calibration.

Classical means of measuring steady water flow include direct measurements of volume or weight over a period of time, timing the passage of objects or chemicals in the stream, and the use of weirs, orifices, propeller-type current meters, and Venturis. Certain of these methods have distinct disadvantages or are impossible to use in a closed circuit. The advantages of Venturi meters include mechanical reliability and the fact that no large disturbance is created in the flow which might cause release of air bubbles or cavitation. Accuracy can be obtained if each meter is calibrated and periodically recalibrated. The disadvantage of Venturi meters is that pressure differentials large enough for reasonable accuracy cannot be obtained in one Venturi over the full range of flow required for this laboratory. Therefore four Venturi meters of different sizes are provided to cover the range of 35 cfs to 4 cfs. Each is used for rates of flow giving pressure differentials between 3 ft and 17 ft.

Connections from the resorber are provided for two meters to be available at the same time, with one or the other isolated by means of a valve. Two meters are sufficient to cover the range of testing of any one model. The other two meters are stored adjacent to the circuit and can be substituted quickly. Changes are made by rolling one meter out of the way and replacing it with another, without need of a crane or lifting device. The 30-in-diam inlets of the meters are connected to a valve chamber above the resorber, with double-seal valves sealing with inflated rubber tubes. Two seals are employed on each valve to provide a space which can be drained for

[4] "The Hydrodynamics Laboratory of the California Institute of Technology," by R. T. Knapp, Joseph Levy, J. P. O'Neill, and F. B. Brown, Trans. ASME, vol. 70, 1948, pp. 437–457.

detection of leaks when the valve is closed. This feature guarantees that no water will pass through the closed valve.

The Venturi meters are of cast iron with smoothly bored water passages. The inlet and throat of each meter are lined with stainless-steel rings, with gaps 0.015 in. wide between the rings for piezometer connection.

Head Tank. The head tank is a plate-steel structure roughly 10 ft diam × 7 ft high in which the model turbines are placed. Turbine testing usually is done in a flume setting; that is, water is allowed to enter the wicket gates directly from the head tank, but the head tank is also large enough to install complete model spiral cases. The head tank acts as a structural support for the turbine, so the head-tank-and-tailrace assembly is kept separate from the building structure and other equipment, to prevent snow and wind loads on the building and temperature variations from affecting the line-up of the test equipment. For similar reasons, windows on the south side of the building were omitted to prevent the sun from shining on the support columns.

The head-tank bottom, which supports the model turbine, deflects more or less as the pressure is increased or decreased. To prevent misalignment of the turbine with the shaft, which is separately supported on the brake structure, the tank bottom has been stiffened with heavy beams as shown in Fig. 3.

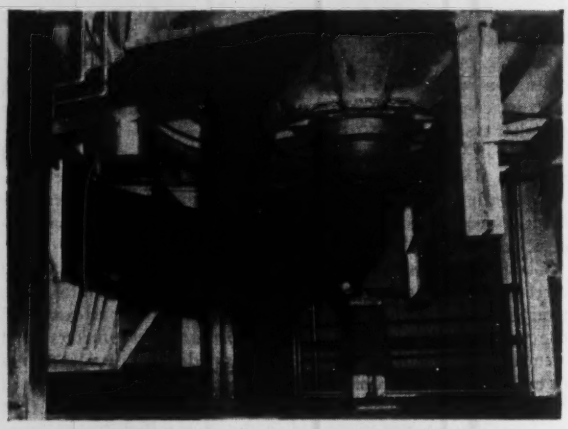

FIG. 3 BOTTOM OF HEAD TANK SHOWING DRAFT TUBE AND STIFFENING BEAM

The connection between the 24-in. piping from the Venturi meter and the head tank is made by a plate-steel section 5 ft diam × 7 ft long, containing three screens for smoothing out turbulence in the flow.

Turbine. The model turbine is designed to use runners of 16-in. throat diameter for high specific speeds and 16-in. tip diameter for low specific speeds. The majority of testing is done with the 16-in-throat-diam runners, which can all be used with the same draft tube. For the low-specific-speed runners, two additional draft tubes are required. A variety of distributors are available with different combinations of diameter, number of gates, and gate height.

The turbine is supported on the tank bottom and mounted close to it, so that changes of draft tube may be made conveniently. This feature is also desirable in that transparent draft tubes may be used for stroboscopic studies of conditions below the runner.

The turbine wicket gates are servomotor-operated by pressure from an outside water supply. The servomotor operating valve also is used to control a brake to lock the gates in any given position. A geared selsyn indicator connected to one gate stem transmits the gate position to the control panel.

A phenolic-plastic bearing in the turbine head cover is used to center and steady the shaft. A small amount of water may be allowed to escape through this bearing to the outside, where the flow can be observed.

A stuffing box in the cover of the head tank prevents all but an occasional drop of water from escaping along the shaft. Leakage through the stuffing box may be observed and corrected if it becomes excessive.

Tailrace. An elbow-type draft tube leads from the runner throat to the tailrace, which is a plate-steel vessel designed to withstand full atmospheric pressure from the outside. A baffle inside the tailrace tank leads the water smoothly into the 24-in. vertical pipe which returns the water to the lower level and back to the first stage of the pumps. At low rates of flow through the turbine the velocity of the water in the 24-in. pipe would be so low that air bubbles would float to the top and accumulate in the tailrace tank. Therefore a by-pass is provided from the resorber to the tailrace tank, where the water is injected in such a way as to prevent formation of air pockets and to raise the water velocity in the discharge pipe high enough so that air bubbles are carried along to the pumps.

Main Piping. The piping connecting the Venturi meters to the head tank, the tailrace to the pumps, and the pumps to the resorber, is plate-steel welded pipe of 24 in. diam. The maximum velocity is 11 fps. All bends are abrupt miter bends with turning vanes, similar to the elbows normally used for wind tunnels.

Pressure Regulator. The pressure regulator consists essentially of a pressure tank with air and water-inlet and outlet valves, and water-level and pressure governors. It holds about 50 cu ft of water and 50 cu ft of compressed air. The water level in the tank is maintained automatically by means of a "Magnetrol" level control equipped with electric switches for operation of water-inlet and outlet solenoid valves. The air pressure in the upper portion of the tank is governed automatically by means of an adjustable pressure gage equipped with apparatus for operation of solenoid air inlet and outlet valves.

The pressure tank is connected to the circulating system through a 6-in. pipe line to the upper compartment of the resorber, where the flow and pressure conditions are expected to be most steady. The large connecting pipe is to maintain a minimum pressure difference between the tank and the resorber, by keeping velocity head and friction losses small.

Refrigerator. A large part of the energy supplied by the pumps is not absorbed by the turbine and heats up the water in the circulating system. It is desirable for consistency of test results to keep the temperature of the water within a range of 10 deg F. It is estimated that the water will warm up to about 10 deg during 8 hr full-power operation. On this basis, and having intermittent service in mind, cooling equipment has been installed which reduces the temperature in 48 hr by 10 deg.

Dynamometer. The brake is of the electromagnetic eddy-current type, rated at 400 hp brake effort at 2000 rpm and suitable for 150 hp at speeds as low as 600 rpm. A standard Midwest Dynamometer Company horizontal shaft unit was equipped with a new shaft and special bearings for vertical shaft arrangement, Fig. 4.

The dynamometer is mounted on a separate structure which straddles the head tank and goes down to solid foundations, in order to avoid misalignment by changing weights and pressures in the hydraulic circuit.

The brake is equipped with a generator connected to the electronic control apparatus of the brake. This electronic

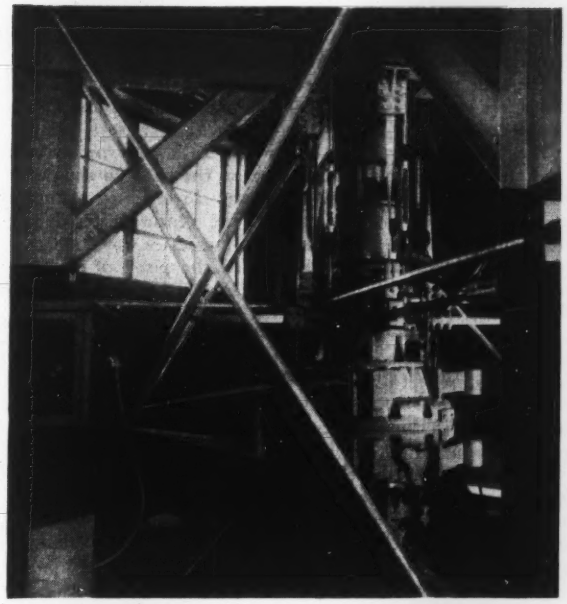

FIG. 4 DYNAMOMETER

apparatus serves as a governor by regulating the current in the field coil of the stator and holds the turbine speed practically constant for considerable load variations, since the speed drop is only 4 per cent from no load to full load. The device also can be used to govern at constant load instead of at constant speed.

The brake is equipped with an auxiliary shaft which drives an electric tachometer and a chopper disk providing light impulses for an electronic speed counter.

The dynamometer is suspended by four thin steel bands, each 2 in. wide × 0.05 in. thick, and eight horizontal bands serve to hold the dynamometer in alignment with the turbine shaft. Each band is twisted 90 deg so that there is negligible resistance to bending in any direction. The horizontal bands are stretched to about 1000 lb tension. The dynamometer is thus held by a system of springs, with negligibly small resistance to small rotations about its axis. The resistance is not negligible if the rotation is substantial, for the horizontal bands must stretch and the brake must be lifted by the vertical bands if rotation occurs. Therefore the torque is measured by a device which allows only a small movement of the torque arm. This condition is met by a weighing scale of special construction, described later. The scale is calibrated in foot-pounds torque and the reading is transmitted by selsyn to the control panel. Between the limits of the balanced position, the scale allows a small movement of the torque arm which could introduce an error as high as 0.1 per cent for the smallest torque measured.

The torque arm, which is rigidly made, can spring as much as 0.001 in. for 1090 ft-lb torque, but the small apparent error introduced by this rotation is covered by static calibration.

The suspension bands are relatively highly stressed, so the hydraulic thrust on turbine runners can be calculated easily by measuring the stretch of the bands.

Measuring Scales. The scales used for measuring the pressure at the head tank and tailrace, and the pressure differential across the Venturi meter, are similar to the scales shown in Fig. 5. The principle is illustrated by the diagrammatic sketch of the Venturi meter scale, Fig. 6. A similar scale is used for setting the pressure in the pressure regulator, and another similar scale, with the piston replaced by a system of levers, is used for measuring the forces exerted by the dynamometer arm.

The hinge points throughout the scales are frictionless "Cardan" hinges made with thin flat springs. By adjusting the weight of the counterpoise in the correct relation to the lever lengths and piston area, the revolution counter geared to the screw which moves the counterpoise along the beam is made to read directly in the desired units, such as feet of water or foot-pounds torque. The reading of each revolution counter is transmitted to a similar counter at the control panel.

The counterpoise is moved automatically to the balance position by means of the "Tektor" capacitance proximity switches. The motor and revolution counter are mounted on the beam and all electrical connections are made through mercury wells, so that no appreciable forces are transmitted to the beam except by the piston or brake arm, as the case may be.

The Tektor switches may be adjusted to control the position of the end of the beam within a few thousandths of an inch, corresponding to an acceptably small error in scale reading. They also may be adjusted to allow considerable movement of

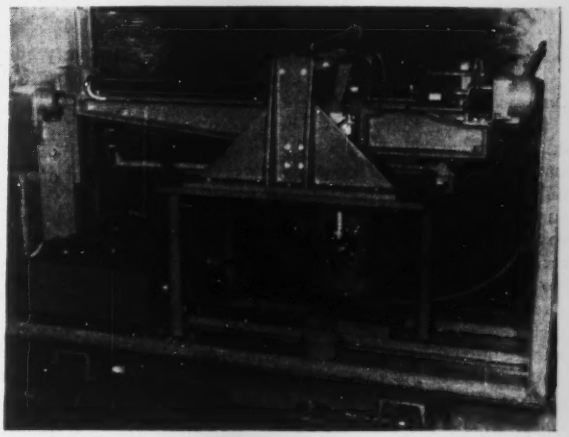

FIG. 5 PRESSURE-MEASURING SCALE

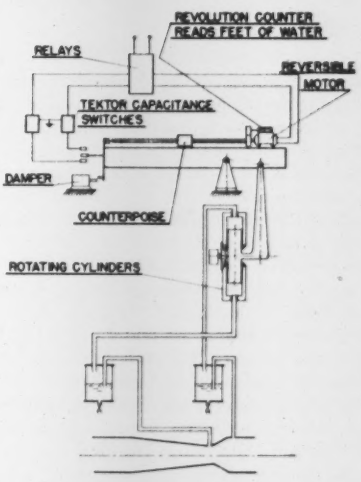

FIG. 6 DIAGRAMMATIC SKETCH OF VENTURI-METER SCALE

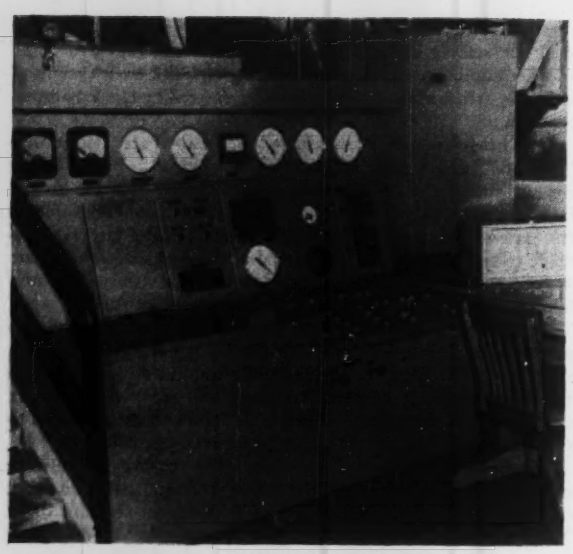

FIG. 7 CONTROL PANEL

the beam when it is desired to establish approximately the correct position of the counterpoise without taking time for extremely accurate measurements.

Control Panel. The control desk is shown in Fig. 7. Bourdon-type gages give a rough indication of the various pressures, and revolution counters give the exact values transmitted from the scales. Colored lights indicate whether the various scales are in equilibrium and a button is available for damping all the scales simultaneously. When the lights indicate that all the scales are in balance the revolution counters may all be locked in position by pressing a button, which also starts an electronic speed counter which integrates the turbine revolutions for 1 sec and shows the revolutions per minute directly on the instrument panel. In this way one observer takes all the readings simultaneously. From this same position the operator can control the pressure regulator, the pumps, and the brake, so one man can do a complete turbine test without leaving the control desk. In practice there is another man to calculate and plot the results as the readings are taken and another who carries on a continuous inspection of the equipment.

CALIBRATION

Venturi-Meter Calibration. The Venturi meters were calibrated by using the main pumps to pump water through them for a known period of time into a tank where the volume could be measured accurately. Readings of the pressure differential were taken on the Venturi-meter scale, which had been calibrated previously to read in feet of water so that comparison could be made with published data on Venturi meters.

The volume of flow was measured by pumping through the meter into a 4000-cu-ft calibration tank. Owing to deflection of the tank walls under the water load it was necessary first to calibrate the tank by measuring the level change with the addition of known volumes of water. The known volume was a tank whose capacity had been established by weighing the water required to fill it at two different temperatures.

The measured time was determined by switching the discharge from the Venturi meter across a knife-edge into the calibration tank and out again. The time was measured with the electronic counter and precautions were taken to assure that the time interval started when the center of the jet from the discharge nozzle crossed the knife-edge and stopped when the center of the jet again crossed the knife-edge, moving at the same speed in the opposite direction.

The scale reading of the pressure differential across the Venturi meter was recorded by a motion-picture camera during the time interval.

The water was pumped from the main reservoir of the laboratory during these calibrations so the head on the pump changed appreciably during each run. In order to maintain a reasonably constant flow through the Venturi meter during the timing period, one of the measuring scales was connected to relays which automatically varied the pitch of the propeller-pump blades so as to maintain the differential in the Venturi meter constant during each run.

Dynamometer Calibration. To calibrate the scale on the torque arm of the dynamometer, weights were hung on a flexible cable over a rigid wheel to apply a force at a known radius on the torque arm. The weight of the counterpoise on the scale beam was adjusted to cause the scale counter to read directly in foot-pounds torque.

The windage of the brake and shaft, the upper and lower guide bearings on the turbine shaft, and the turbine-shaft stuffing box all take work from the turbine which is not measured by the dynamometer. The lower turbine bearing and the stuffing box may be equivalent to their counterparts on prototype turbines, but for comparative purposes it is desirable to know the friction torque to be able to calculate the power developed by the turbine runner. To achieve this a calibration motor is mounted permanently on the dynamometer frame with the rotor on the same shaft as the dynamometer rotor. The friction and windage losses were measured at three different speeds by running this motor with a cap over the end of the turbine shaft to pressurize the water-lubricated bearing and stuffing box. Windage and friction losses were found to be so small that no correction will normally be made for them.

Pressure-Measuring-Scales Calibration. The measuring scales were calibrated against both mercury and water manometers. Final calibration was done by photographing the mercury manometer and checking it against readings of the scale counters, taken simultaneously. The weights of the counterpoises of all the scales were adjusted so that the scales read directly in feet of water.

All the calibrating arrangements are of a permanent nature so that calibration of any part of the equipment may be checked periodically, or whenever there is any doubt about the accuracy of the results.

CONCLUSION

Now that this new cavitation laboratory is operating full time, it is hoped that before long there will be an opportunity to present significant comparisons between laboratory and field experience. It is suggested that through the ASME Hydraulic Prime Movers Committee it may be possible to assemble data from interested turbine manufacturers and power companies, to learn more about the correlation between laboratory cavitation tests and field-operating experience.

ACKNOWLEDGMENTS

Acknowledgment is made of the help of Dr. R. T. Knapp of the California Institute of Technology and Mr. S. Logan Kerr, Consulting Engineer, who both acted in a consulting capacity on the design of the Dominion Cavitation Laboratory. The senior author also obtained many useful ideas on a visit to the Hydrodynamics Laboratory of the California Institute of Technology. The work of Messrs. J. Desbaillets and M. Hofer, and the laboratory staff, with the many ideas they contributed, has been of great assistance.

THEORY OF GAGING

A Review of Mechanical, Electrical, Electronic, and Pneumatic Systems

By W. FAY ALLER

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SOMEONE has provokingly said that man's forward progress has been marked by his increasing ability to divide the inch smaller and smaller. The worn shilling—the early feeler gage that James Watt couldn't insert between the bore and piston of his steam engine—shows that the division was already starting in 1798. The worn shilling was one extreme. By contrast, today industry requires precision in production, in some cases of five-millionths' limit on aircraft fuel-injection parts.

It is the purpose of this paper to acquaint the reader with the fundamental principles and characteristics of several of the mechanical, electrical, electronic, and air gages that have made this separation possible and offer possibilities for further advancement in the never-ending effort to give industry better tools. The list is by no means complete, but the examples selected were chosen because they serve to demonstrate types. There is no attempt to be complete or precise in circuity as the object is to show principles rather than details.

In the sequence of their development and use we will start with mechanical gages.

MECHANICAL INDICATING GAGES

Mechanical indicating gages employ various methods to achieve amplification of movement. The purpose of this

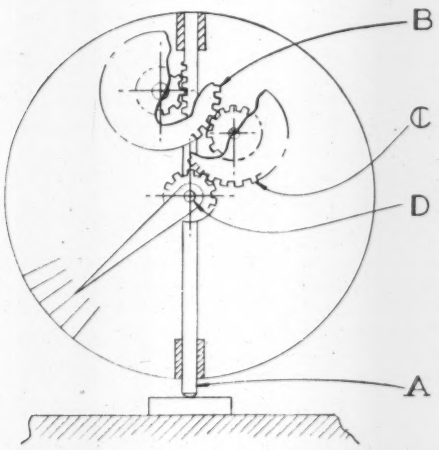

FIG. 1 BASIC OPERATING PRINCIPLE OF DIAL INDICATOR

amplification is to translate a minute displacement of a stylus or gage point, resulting from contact with a specimen, into a value on an indicating scale. It is desirable that this value be read quickly and easily.

Amplifying units in such gages utilize many commonplace mechanical devices such as: simple and compounded levers; racks, pinions, and gears; spring-steel reed mechanisms; and optical elements, including lenses, prisms, and mirrors. In some cases various combinations of these relatively simple devices are employed to provide greater accuracy or a higher magnitude of amplification.

Probably one of the most commonly known gages in this category is the dial indicator, Fig. 1.

Essentially, this gage consists of a gaging stylus A, having involute rack teeth on one end meshing with assembly B, compounding through assembly C to the pointer shaft D. Thus amplification of this gage is obtained solely by the ratio of the various pinions and gears, plus the length of the indicating pointer. The scale is arranged radially around the outer periphery of the scale plate. The dial-indicator gage when rigidly

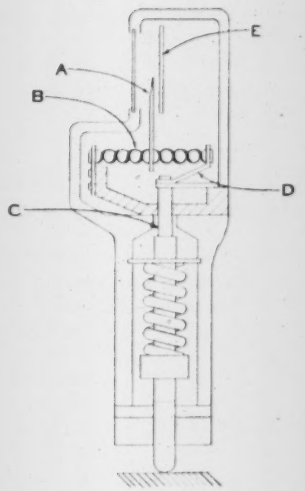

FIG. 2 THIS COMPARATOR EMPLOYS 100 PER CENT MECHANICAL AMPLIFICATION WITHOUT GEARS OR PIVOTS

mounted on a gage stand or in fixed position on a gaging fixture will indicate dimensional deviations of the part being gaged with respect to a reference surface.

This device is manufactured in a variety of amplifications and has a number of advantages:

1 It may easily be mounted on fixtures or used as a simple comparator.

2 When new or well maintained it has reasonably good accuracy.

3 It has fixed amplification, requiring usually only one master for set up.

4 It has an extremely long gaging range relative to amplification.

In a product having so many advantages one must expect also a few shortcomings:

1 It is limited in accuracy for precise use.

2 Its maintenance cost relative to initial cost is not favorable.

Contributed by the Production Engineering Division and presented at the Annual Meeting, New York, N. Y., November 30–December 5, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

3 It requires frequent surveillance to determine when maintenance is needed.

A second dial-type indicator gage employing 100 per cent mechanical amplification is shown in simple cross section in Fig. 2.

The pointer A is mounted on a twisted strip of metal B. The twist of the strip is left-hand on one side of the pointer and right-hand on the other. Elongation of the strip causes it to unwind, thus rotating the pointer. The upper end of the gaging stylus C is fastened directly to the horizontal member of the spring knee D. The other member of the knee is attached to one end of the strip B. The opposite end is fixed permanently to the frame of the gage. Vertical movement of the stylus causes an elongation of the strip and the amount of resulting radial movement of the pointer is indicated on the scale.

This mechanism while capable of rather high amplification has a limited range. Being somewhat larger than the usual indicator it is not easily applied to fixtures but is used as a comparator. It is also of the fixed-amplification type requiring one setting master.

A widely used indicating comparator-type gage embodying combinations of mechanical and optical elements is shown diagrammatically in Fig. 3.

The fixed block A supports a vertically floating block C by means of two horizontal reeds or flat springs B. The floating block carries the gaging stylus D. Between the fixed block and the floating block are two vertical reeds E, to which the pointer F carrying the target G is attached. The target intercepts a beam of light initiated by the light source and optical assembly. The resulting image projected upon the scale K indicates, highly amplified, any stylus movement.

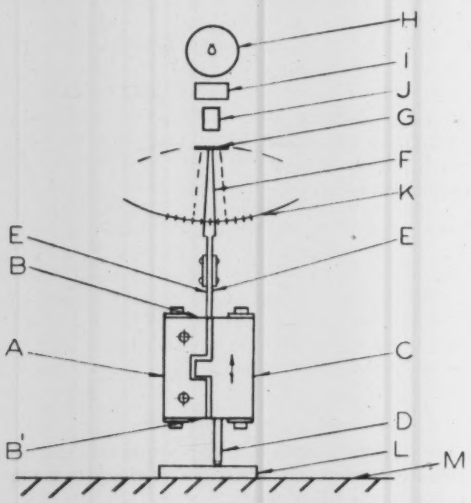

FIG. 3 WITH ONLY MOLECULAR FRICTION BOTH OPTICAL AND MECHANICAL PRINCIPLES ARE COMBINED IN THIS RUGGED AND ACCURATE COMPARATOR

This unit is usually of the bench comparator type because of its size. It has extreme accuracy, speed of response, and fixed amplification. Because of its rugged construction and completely frictionless mechanism, it has a very long life with little maintenance. The mechanical amplification is usually less than 100, but is multiplied by the optical light lever. It is available in amplifications ranging from 500 to 20,000.

There are many other types of mechanical gages which brevity will not permit explaining. The three examples selected should give a fairly comprehensive understanding of the principles involved in mechanical gages.

ELECTRICAL GAGES

There are many kinds of electrical gages for dimensional use. Only those systems more commonly used for the inspection of precision metal parts will be discussed. These can be classified into two general groups:

1 Those which indicate arithmetical values of dimensional units, we shall refer to as the "instrument" type.

2 Those which indicate only whether the dimension is within tolerance, oversize, or undersize, we shall refer to as "limit" type.

The instrument-type gages can be classified further by the type of pickup head or transducer used. Reference to Fig. 4 indicates four general types of such units.

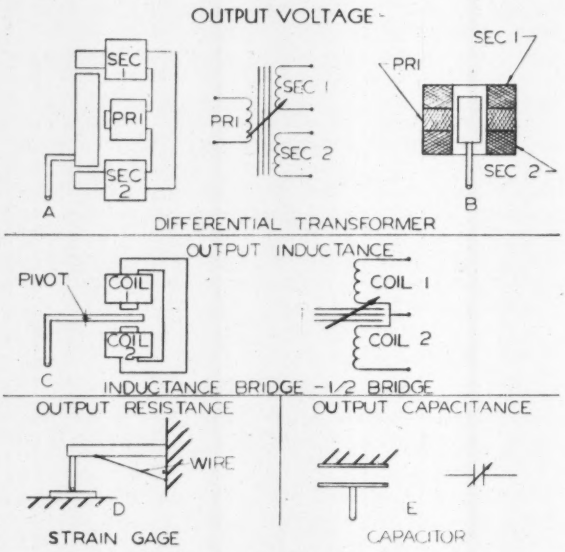

FIG. 4 ILLUSTRATING VARIOUS GENERAL TYPES OF ELECTRICAL TRANSDUCERS TO SHOW PRINCIPLE OF OPERATION

No attempt has been made to show exact mechanical arrangement but rather to indicate the principle of operation. Note that each type is characterized by different outputs, such as voltage inductance, resistance, and capacitance, requiring, of course, circuity in the auxiliary equipment to handle the particular type and level of output.

In general, the differential-transformer transducer or gage head is built in the two types illustrated. While the construction is different, the principle is the same. A single primary winding is used in connection with two secondary windings, so that when the armature is centered mechanically, the magnetic-flux secondary No. 1 with the primary is of the same magnitude as that linking secondary No. 2 with the primary. Under such conditions the voltages induced in these two secondaries are equal. Movement of the armature in either direction from this position causes an unequal distribution of magnetic flux in the two paths, resulting in the voltage increasing in one secondary and decreasing in the other in proportion to the magnitude of movement. Movement from neutral in the reverse direction results in just the opposite distribution of voltage in the two secondaries.

By proper circuity the indicating meter can be made to in-

dicate plus and minus directional movement from the center in addition to magnitude. Note that the main difference between arrangements A and B, is that the flux paths in A are primarily in iron while in B are mostly in air.

Arrangement C is based on the change of inductance of two coils as an armature is pivoted between the two pole faces. As this armature is moved from center position, the inductances of the two coils vary in approximately inverse relation to the air gaps, one increasing and the other decreasing. Incidentally, inductance can be loosely defined as the resistance to the passage of an alternating current.

Arrangement D is based on the change of resistance of a metal wire as it is placed under a strain. Its resistance will increase as the wire is stretched because of the increase in length and decrease in cross section and in certain materials not used for comparator applications, also as a result of the change in resistivity of the metal occasioned by molecular strain. The

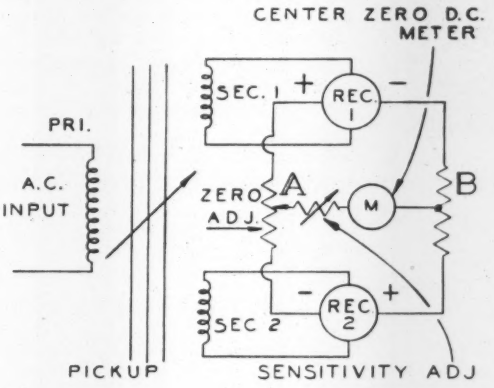

FIG. 5 A SIMPLE ELECTRICAL GAGE CIRCUIT FOR DIFFERENTIAL-TRANSFORMER-TYPE GAGE HEAD

gaging stylus is used to stretch the wire which is usually a special alloy whose resistance is very stable against temperature changes.

Arrangement E is based on the change of capacitance of a parallel-plate condenser as the distance between the plate is varied. The first three arrangements are probably the most popular and, in general, are characterized by very good stability. In addition, arrangements A and C can be designed for high output so that electronic amplifiers are not required. The other transducers have such low output that amplifiers are a must.

The general trend is toward the use of electronic amplifiers with all types of transducers because of the flexibility and high amplification possible. For stability reasons it may be necessary to design the transducer for small output even though the type is capable of high output.

Capacitor types of transducers are not in general usage.

ELECTRICAL AND ELECTRONIC GAGES

Fig. 5 is a simplified nonelectronic circuit for the differential-transformer-type gage head. An a-c power source, usually regulated, is required to excite the primary winding.

By means of dry-disk rectifiers the output of each secondary is changed to direct current. These are connected as shown so that when the armature of the gage is in mechanical center or neutral the a-c voltage outputs of the secondaries are equal and consequently so are the d-c outputs of the two rectifiers. Under such conditions, if the zero adjustment is centered, the voltage between points A and B is zero and the meter reading will be zero. When the armature is displaced these voltages no longer are equal causing the voltage between points A and B to increase in direct proportion to the armature displacement. As the armature moves from one side of neutral to another the polarity of the voltage changes so that the meter then reads in the opposite direction, allowing the operator to distinguish between plus and minus armature displacement.

For convenience in setting the gage an electrical zero adjustment is provided so that the meter can be made to read zero even though the armature is slightly displaced from mechanical center. A sensitivity adjustment allows the gage amplification to be set to the correct value.

Electronic and straight electrical gages are commercially available in amplifications as low as several hundred to as high as 100,000. The highest-amplification gages are used primarily for gage-block calibration. These gages have been built for many years and are capable of giving excellent service even under adverse conditions.

Fig. 6 shows a typical electronic-type unit using a differential-transformer-type gage head. In theory the main difference between this and the straight electrical type is that the output of the gage heads is amplified many times before it is rectified or detected and applied to the meter circuit.

The second general class of electrical gages, limit gages, are used primarily for semiautomatic types of gaging. Basically, these gage heads are extremely sensitive limit switches. In fact, where very high sensitivity is not required precision limit switches serve as gage heads.

Fig. 7 shows a limit-type gage head specifically designed for gaging service. The gage stylus movement is amplified by a reed mechanism which causes the needle arm to open or close two sets of adjustable electrical contacts so that both the plus and minus limits are adjustable separately. The contacts are used to operate indicating lights or relays.

Electric and electronic gages have added greatly to the science of gaging. In many cases they have given the flexibility of mechanical gages plus an increase in accuracy and usefulness. A still greater combination of flexibility and accuracy is found in the modern air gage.

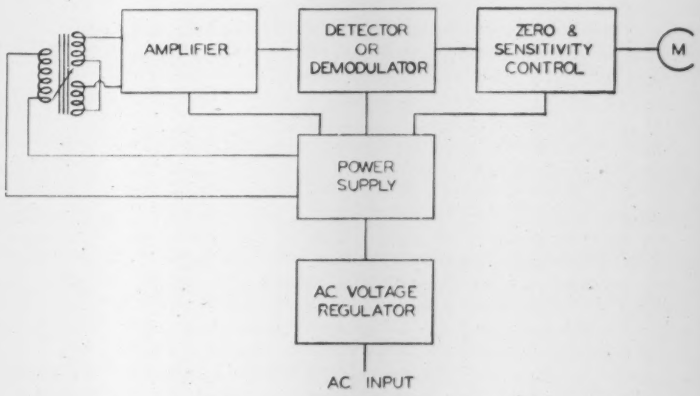

FIG. 6 TYPICAL ELECTRONIC UNIT USING DIFFERENTIAL-TRANSFORMER-TYPE GAGE HEAD

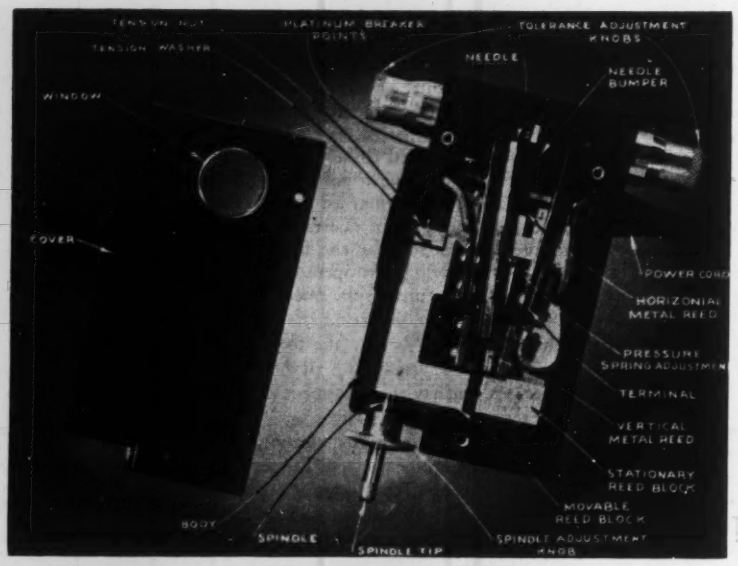

FIG. 7 GAGE HEAD FOR LIMIT-TYPE COMPARATOR USING ADJUSTABLE ELECTRICAL CONTACTS

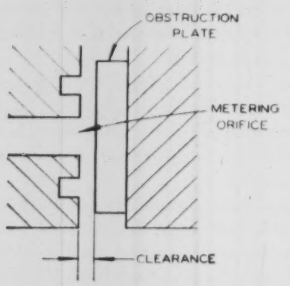

FIG. 8 ILLUSTRATING BY USE OF OBSTRUCTION PLATE THE FLOW CHARACTERISTICS OF AN AIR JET

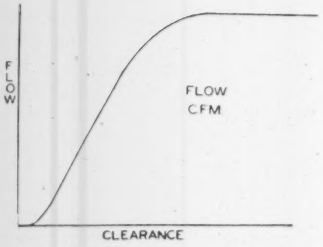

FIG. 9 SHOWING RATIO BETWEEN CHANGE OF AIR FLOW AND DIMENSIONAL CLEARANCE

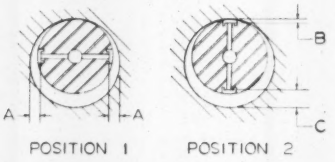

FIG. 10 WHEN AIR SPINDLE IS PLACED AS SHOWN IN POSITION 1, TOTAL FLOW FROM EACH METERING ORIFICE MUST EQUAL FLOW WITH SPINDLE AS SHOWN IN POSITION 2 TO OBTAIN ROTATIONAL ACCURACY

PNEUMATIC GAGES

An air gage is basically a comparator gaging device that utilizes the effect of minute dimensional changes on metered air in a gaging circuit.

There are two basically different approaches to measuring the metered air. One method is to measure the flow of air that is metered through the orifice. The other measures the variations of pressure in the gaging circuit by means of restriction prior to the pressure-measuring device and the metering orifice.

The flow of air that is metered through an orifice with an obstruction plate in front of it as in Fig. 8, will change as the "clearance" from the metering orifice to the obstruction plate is changed.

A typical curve illustrating the change in flow per increment of dimensional change or clearance is shown in Fig. 9. It will be noted that the first small dimensional clearance indicates no flow. As the clearance is increased, the change of flow per unit of dimensional clearance increases. At a certain point the change in flow becomes uniform with the change in clearance and so remains for a definite range. When this range is passed, the change in flow gradually decreases per increment of dimensional clearance until there is no flow change.

The straight portion of the curve is the range in which all dimensional measurements take place. The reason for this may best be illustrated by an application of gaging which is the most common, namely, the air spindle for measuring internal diameters. If the air spindle is placed as shown in position 1, Fig. 10, the summation of flow from each metering orifice must equal the flow with the spindle placed as shown in position 2. Otherwise a false indication of diameter would be registered since the dimensional addition of A plus A equals that of B plus C. The actual length of the straight position of the curve and its starting point depends on two factors, namely, the orifice size and the air pressure at the orifice.

Our first example is an air gage utilizing the flow principle of measurement. Briefly this consists of an indicator that floats in a cone of air passing through a tapered glass column, prior to escaping from the metering orifice, as shown in Fig. 11.

Air from a factory line is passed through a filtering element, a regulator for controlling pressure precisely, a developed glass tube in which the indicator floats, and then through

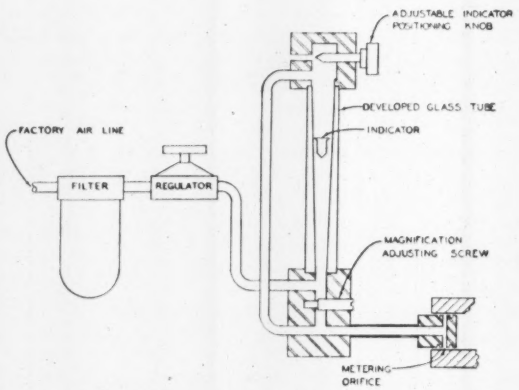

FIG. 11 ILLUSTRATING PRINCIPLE OF AIR-FLOW-TYPE GAGE

the metering orifice. The amplification of the gage is approximately controlled by the amount of the developed taper in the tube. Two adjustments have been provided for setting amplification. One is an atmospheric bleed which positions

the floating indicator. The other is a magnification adjusting screw for changing amplification. Two masters are used for setting amplification.

This principle allows a wide range of amplifications plus extreme accuracy and 50,000 amplification is available without the use of accessory equipment. Since the flow principle is employed the measuring nozzle may be at considerable distance from the instrument without preceptible loss of speed of indication. The vertical tubes may be grouped conveniently for observing a number of dimensions simultaneously. It is the ultimate in simplicity and is free of small restrictors and wearing mechanical parts.

Another style gage uses a Venturi principle. This gage is shown in Fig. 12.

Air from a factory line passes through a filtering element, a regulator for controlling pressure, into a large Venturi chamber that converges into a smaller Venturi chamber and on through the metering orifice. Each chamber of the Venturi has a pressure tube connected to opposite sides of a bellows. The low-velocity air, passing through the larger Venturi, creates a higher pressure on the bellows than the higher-velocity air passing through the smaller Venturi chamber creates in the bellows. The difference in pressure causes the bellows, which

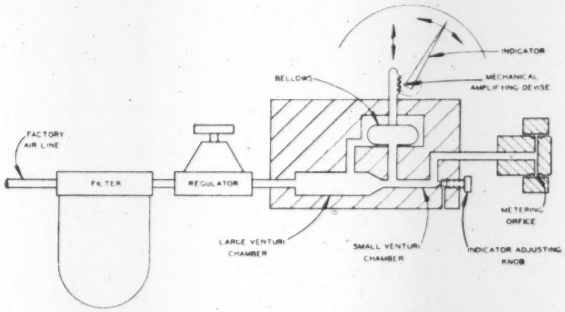

FIG. 12 OPERATING PRINCIPLE OF VENTURI-TYPE GAGE

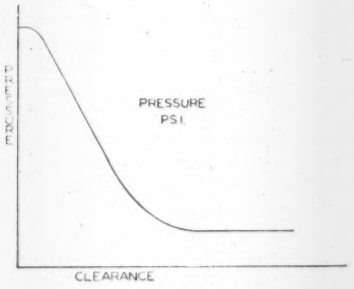

FIG. 13 CURVE SHOWING RATIO OF BACK PRESSURE AND CLEARANCE

is in effect a spring, to move until the spring pressure from the bellows plus the lower pressure in the bellows is in balance with the pressure exerted on the bellows. The deflection of the bellows is then measured by a mechanical amplifying device similar to a dial indicator. The amplification may be varied by changing the ratio of diameters in the large Venturi to the small one. The greater the difference in diameter the greater the amplification. In general, the diameter of the smaller Venturi chamber is from 25 to 50 per cent of the diameter of the larger.

Two adjustments are provided for setting the amplification. One is an atmospheric bleed for positioning the indicator, the other a pressure regulator for adjusting amplification. Two masters are used to set amplification.

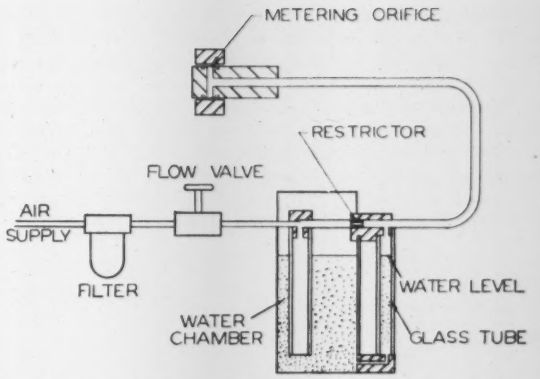

FIG. 14 BASIC PRINCIPLE OF WATER COLUMN-BACK PRESSURE GAGE

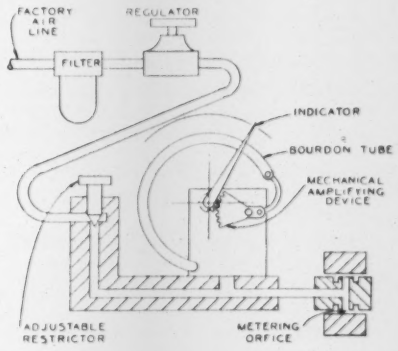

FIG. 15 BOURDON TUBE INDICATES BACK-PRESSURE CHANGES DUE TO VARYING CLEARANCE BETWEEN ORIFICE AND PART BEING GAGED

The back pressure, created by placing an obstruction plate near an orifice, causes a pressure change in the downstream side of the restricted air circuit. A typical curve for showing the pressure changes per increment of dimensional or clearance change is shown in Fig. 13.

In the first minute dimensional changes there is no pressure change. As the clearance increases, the change in pressure per unit of dimensional clearance increases. At a certain point the change in pressure per unit of dimensional clearance change becomes uniform and remains so for a definite range. When this range has passed, the change in pressure per unit of dimensional change decreases until there is no pressure change. The starting point and the linear range depend on:

1 The amount of amplification.
2 The size of the orifice.
3 The pressure range of the orifice.

The water-column gage, Fig. 14, utilizes air from a factory line passing through a filter and a flow valve, a water chamber, a restriction, and escapes from the metering orifice. The air pressure is maintained at a constant value as determined by the height of the water column in the water chamber.

The restriction meters the air into the gaging circuit in which the water column will register changes in pressure caused by variations in orifice clearance. Two masters are used to determine amplification.

The Bourdon tube or bellows in a restricted air circuit is used in another type back-pressure gage shown in Fig. 15. Air from a factory line passes through a filter, a regulator for controlling

pressure, and a restriction for metering the air, into the gaging circuit. A Bourdon tube has been placed in this circuit to indicate pressure changes due to varying the clearance between the orifice and the part being gaged. The pressure changes in the Bourdon tube causes it to deflect. These deflections are amplified by a device similar to the mechanism of a dial indicator. Two adjustments have been provided to set amplification. One is the regulator for varying air pressure, the other the restriction for altering the amount of air that is metered into the

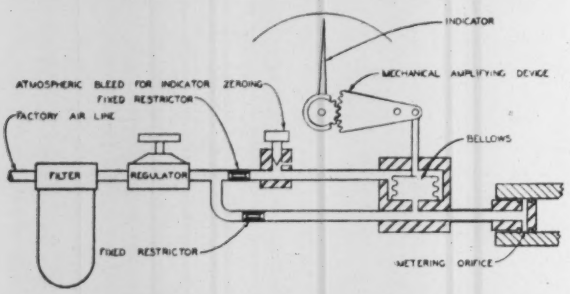

FIG. 16 ILLUSTRATING PRINCIPLES FOR OPERATION OF DIFFERENTIAL-GAGING CIRCUIT

gaging circuit. Two masters are used for setting amplification.

The differential circuit using a bellows is another type of back-pressure gage, Fig. 16.

Air from a factory line passes through a filter and a regulator for controlling the pressure. The air then passes into two separate channels, one having a fixed restriction, an atmospheric bleed for indicator zeroing, and terminating in a cavity containing a bellows. In the other channel, air passes through a fixed restriction into a cavity on the opposite side of the bellows and through the metering orifice. In this air circuit the difference in pressure in the zeroing side of the circuit and the gaging circuit causes the bellows to move. The movement of the bellows then is amplified mechanically by a dial-indicator-type mechanism. One adjustment is provided for zeroing the indicator. Like all other air gages one master is provided for use in conjunction with the zeroing adjustment although two masters are required to determine or check amplification.

In general, the back-pressure circuits provide speed of gaging when the gaging nozzles are near the instrument. Gaging more remotely or using the higher range of amplification, however, seriously retards this speed.

Satisfactory instruments are being offered in all of the various circuits and a choice may be made to satisfy the particular requirements.

Considering that practical air gaging has been in use only a little over a decade, wonderful progress has been made. Because of its adaptability to otherwise difficult problems its growth in popularity has been very rapid. New applications are found daily.

CONCLUSION

Modern air gaging, in general, has greatly increased man's ability to measure accurately, rapidly, and economically. This is due to its ability to be applied to heretofore difficult and even sometimes impossible problems of measurement. Its usefulness is particularly outstanding in the field of multiple gaging. Air gaging also can be combined to great advantage with electric and electronic gaging devices.

There is no intention to convey the impression that the development of new gaging methods make obsolete the older proved methods. Rather they augment and supply a greater number of approaches to gaging problems and allow the use of the one best-suited for a particular need.

The examples shown have played a great part in dividing the inch smaller and smaller and man's recent rapid progress is reflected in the constantly improved automobiles, airplanes, refrigeration, and all the other things that go with modern living.

World's Largest Forging Press

(*Continued from page 193*)

rigidity of the six main tie rods and by the eccentric load-compensating cylinders. The second phase of this analysis was to consider the dynamics of the press in light of the various modes of possible vibration of the upper entablature of the press under various conditions of normal and assumed abnormal conditions of operation.

AUTOMATIC SAFETY CONTROLS

Notwithstanding extreme care and caution of the press operator in operating the press or the diligence to obtain a safe and foolproof design, malfunction of either some mechanical parts of the press or of the hydraulic control system can cause serious damage to the structure of the press unless adequate safety devices are employed. To remove the element of human error in detecting a dangerous condition, automatic safety controls have been devised which automatically will stop the further operation of the press and simultaneously unload the hydraulic system and thus prevent serious damage to the press. Strain gages are used as detectors and monitors of the stresses in main tie rods of the press. Not only are the absolute values of strain monitored but an electronic control system also will monitor values of strain rate so that for any critical combination of strain and strain rate, the press will be shut down and protected automatically. In this connection it is essential that the time response of the control system be in accordance with that dictated by the study of the dynamic behavior of the press.

CONCLUSIONS

This 50,000-ton-capacity closed die-forging press embodies a new concept of design for heavy presses which is a departure from conventional design as we know it today.

Before undertaking the design of a press of these proportions, it was necessary to determine what limitations existed in the procurement of large heavy steel castings and forgings. There is no point in designing on paper a machine or structure which cannot be built. It was equally important to work closely with the foundries and forge shops to determine the physical properties that could be achieved in various large cast- or forged-steel sections. Thus the design of the press is based on the feasibility of certain large castings, forgings, and weldments.

Engineering-wise, a comprehensive analysis of the press has been made. This analysis covered studies of press stability, automatic controls, safety devices and controls, and detailed stress analysis of all component parts.

Extensive experimental stress analysis on this project was performed in order to confirm adequacy of design. In this connection the company availed itself of the services and facilities of Purdue University, Alabama Polytechnic Institute, New York University, and the University of Illinois.

A Small HIGH-PRESSURE PUMP *for* PILOT-PLANT SERVICE

By RAYMOND W. HITESHUE[1] AND E. L. CLARK[2]

BUREAU OF MINES, REGION VIII, BRUCETON, PA.

CONSIDERABLE trouble has been experienced at the Bruceton Station of the Bureau of Mines in operating low-capacity, high-pressure reciprocating pumps (2000 to 10,000 psi) for continuous pilot-plant and bench-scale work. The wide variety of fluids handled (including mixtures of fluids and solids), the need for good control of flow rates, and the requirement of consistently trouble-free operation contribute to the difficulty of the problem. In many cases, commercially constructed pumping equipment had to be adapted or special equipment had to be designed for a particular service. Most of the troubles have resulted from wear or failure of packing and leakage of valves; the major portion of this paper will deal with these points. Installation and maintenance of pump units also will be discussed.

FACTORS TO BE CONSIDERED

For use at low flow rates (0.5 to 100 lb per hr in pilot plants and 50 to 500 cc per hr in bench-scale units), a packing box must be leakproof so that continuous input and a reasonable mass balance are obtained. This problem cannot be solved by selecting one particular packing design or material for all conditions. Four factors must be considered, i.e., stuffing-box, rod, packing design, and lubrication.

Stuffing box as well as rod must have a surface finish equal to or better than 16 microinches. Excellent rods can be constructed from commercial chrome-plated (0.002-in.) low-carbon steel. The walls of the stuffing box usually are ground with a portable grinder to remove machine or tool marks. Rod and stuffing box must be concentric for the whole length of the rod, as a slight misalignment results in abnormal wear of the packing and prohibitive leakage after a few days of use. A floating rod is an excellent means for assuring concentricity and correcting for slight deviations that may occur in the fabrication and assembly of component parts.

The packing design most extensively used at the Bureau of Mines is the chevron or "vee" type, a self-sealing design fabricated from materials suitable for a particular operation; i.e., duck with a neoprene binder for water, asbestos with neoprene for warm (200 F) tar slurries, and teflon for higher temperatures or more corrosive materials. Three to six rings are inserted on the pressure side, then a lantern ring followed by two to four rings of packing. Metallic adapter rings must be supplied for the female and male faces of each set of packing nests to maintain the packing form.

Lubrication of the packing faces is essential to reduce friction and maintain a tolerable interfacial temperature. Lubrication is achieved by injecting a suitable grease at the lantern rings. One injection per day is usually sufficient. When a liquid-solid mixture (such as a coal-oil slurry) is pumped, continuous lubrication at the lantern ring is highly desirable, as the oil not only lubricates but also keeps solids away from the packing faces. Packing does not seal when subjected to the cutting action of solids. However, continuous injection of oil provides a seal. The injection rate for slurry work has been set arbitrarily at 10 cc per hr when pumping 8 to 30 lb per hr of slurry.

Valves account for some of the operating difficulties. For ease of repair, valve seats must be replaceable, regardless of the design of a pump. Unfortunately, some pump units have the seats cut directly into the pump head so that they cannot be renovated in many shops. With clean liquids, poppet-type valves with a fine machine surface give excellent service for pressures up to 10,000 psi. Dissimilar materials of widely different hardness make a suitable combination, for example, a phosphor-bronze poppet and an 18-8 (type 303) steel seat with a differential angle of 2 to 3 deg. Laborious lapping and grinding are eliminated by this design, which normally is used for pumping liquids of low viscosity, such as water, kerosene, or light oils. Ball-type valves are used for liquids having viscosities exceeding 100 centipoises and for slurries. The valve seats have sharp edges and are fabricated from type 410 or 416 heat-treated steel with a Brinell hardness of about 350. The balls usually are 4 to 6 per cent chrome steel and also are hardened. Coal-oil slurries (35 to 45 per cent of coal) at pressures of 3500 psi have been handled with no valve leakage or plugging. Erosion of valve seats was avoided because of low velocities through the port openings.

SUITABLE PUMP DESIGN

The pump design used at these laboratories for a wide variety of materials is shown in Fig. 1. This particular pump has poppet valves. Both ball and poppet valves are shown in Fig. 2. Such pumps have been used for flow rates of 10 to 30 lb per hr in pilot-plant work and, by decreasing the rod size, have been adapted for bench-scale units requiring flow rates of 40 to 200 cc per hr. The liquids pumped have varied from water to oil slurries containing 50 per cent of powdered coal and heavy oils with viscosities of over 10,000 Engler seconds at 240 F. The pump head is drilled for steam heating.

Fig. 3 indicates the general piping arrangement used at the Bruceton laboratories. It is believed that this scheme adequately protects personnel and equipment. The use of a low pressure safety valve on the suction side of the unit may seem unnecessary at first, but low-pressure piping can be pressurized owing to a faulty suction check valve. A high-pressure safety valve between the pump outlet and the first shutoff valve is considered mandatory on positive-displacement pumps. It is extremely important to install a safety valve directly in the pump head when handling slurries; use of piping between

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Contributed by the Industrial Instruments and Regulators Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and presented at The Seventh National Instrument Conference, Cleveland, Ohio, September 9–10, 1952.

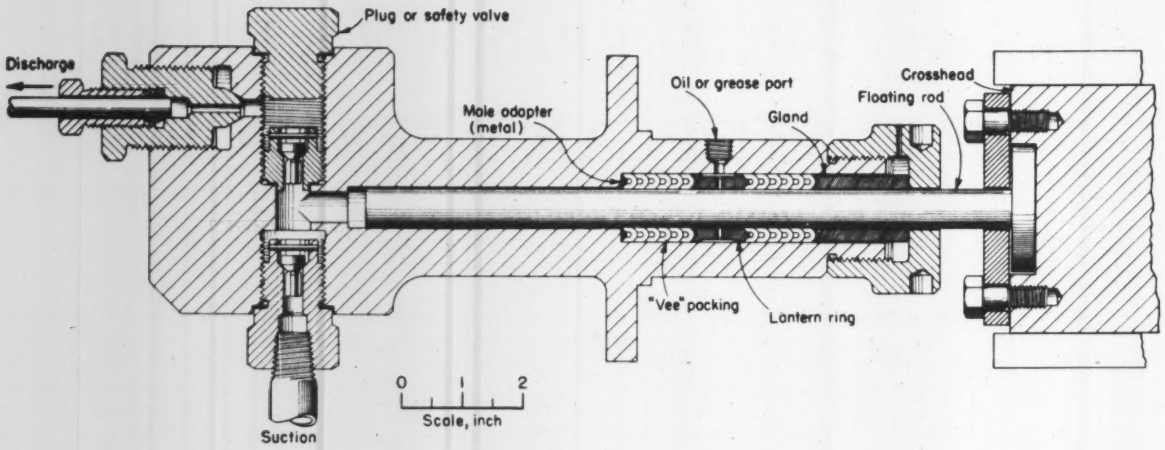

FIG. 1 HIGH-PRESSURE-PUMP HEAD

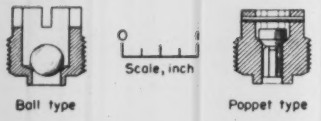

FIG. 2 CHECK VALVES FOR HIGH-PRESSURE-PUMP UNIT

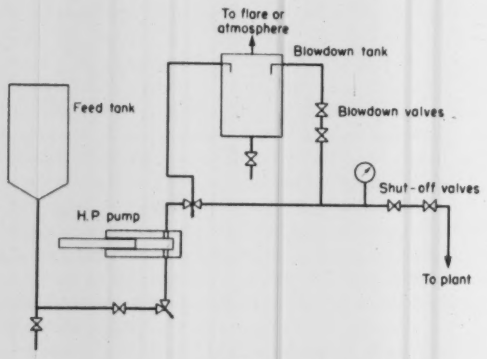

FIG. 3 HIGH-PRESSURE-PUMP INSTALLATION

safety valve and pump is unsafe in such a case. With slurries, stagnant lines to safety valves usually become plugged and thus render the valves inactive. Equipment failures from this source have caused considerable expense and loss of time. Operators should be well grounded in the theory of pump operation and trained by alert supervisors. Emphasis should be placed on the consequences of operating against a dead end. Hand pumps have been useful for demonstrating incompressibility to subprofessional employees.

MAINTENANCE PROCEDURE

Proper design, installation, and operation must be supplemented by adequate maintenance to insure successful experiments. At the Bureau, all pertinent maintenance duties are scheduled, and inspections are carried out routinely. Packings are replaced after 500 to 2000 hr of service, depending upon the severity of operations. When used with clean liquids, valves are replaced every 1000 hr, regardless of their conditions. When used with slurries, valves are replaced at the conclusion of each run. Pump rods are examined for corrosion or wear every 2000 hr. With planned maintenance, nothing is left to memory, and longer and less troublesome runs are possible.

The slurry-pump design of the pilot plant may be compared with the large-scale equipment in use at the Bureau's demonstration plant for coal hydrogenation.[3] There, the rod alignment of commercial pumps had to be improved; suitable lubrication of the packing was necessary; mushroom wing-type valves were replaced by ball-check valves; and the plunger finish had to be improved. The close similarity of the problems encountered in the laboratory and in the plant illustrates the importance of mechanical development on the pilot-plant scale.

Combustion Studies

A TECHNICAL report released recently by the U. S. Bureau of Mines of the Department of the Interior contains highly accurate, basic information valuable for designers of jet engines, rockets, and ramjets.

The report, which covers studies in Pittsburgh on the combustion of methane-air and propane-air mixtures, is part of a research program being handled by the Bureau at the request of the Department of Defense. It tells what results might be expected when various mixtures of methane-air and propane-air fuels are used under different temperatures and at constant pressure.

Although the studies were made specifically for the armed forces, some of the findings probably will be helpful to designers of commercial equipment, such as gas turbines, furnaces, and other devices using natural gas mixtures.

The publication presents in detail the methods of calculation employed and tabulates the temperatures of methane-air and propane-air flames at atmospheric pressure.

A free copy of the publication, "Report of Investigations 4938—The Thermodynamics of Combustion Gases: Temperatures of Methane-Air and Propane-Air Flames at Atmospheric Pressure," can be obtained from the Publications-Distribution Section, Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa.

[3] "Design and Development of High-Pressure Injection Pumps for Hydrogenation Service," by J. T. Donovan, B. H. Leonard, and J. A. Markovits, Paper 51—A-71, presented at the Annual Meeting, Atlantic City, N. J., November 25-30, 1951, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Progress in AUTOMATIC PRODUCTION

By H. L. WADDELL

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BEFORE we can accurately assess our progress in automatic production—or automation—it is necessary to know just what we mean by automation. For industry, at least, automation is a rather new word, and different people use it to mean many different things.

The Ford Motor Company is generally credited with a "reintroduction" of the word in its new industrial connotation; the integration of process machinery with automatic materials-handling equipment.

Even that definition may be interpreted in a very broad or in a very narrow sense. Some people think that a jet of compressed air to remove small parts from a blanking press is an example of automation. Others believe that anything short of a factory that will keep running smoothly without any employees is not true automation.

There can be no doubt that the factory which will run *ad infinitum* without human intervention is an example of automation. But it's hardly a practical basis for a definition. There are few, if any, factories that would meet such a definition today—and there is not likely to be any great number of them for many years to come.

But, since our purpose is to measure progress, we may reasonably accept this as the ultimate in automation. We may then examine our present situation to determine these things:

1 The mechanical requirements of ultimate automation.
2 The managerial requirements of ultimate automation.
3 The socio-economic requirements of ultimate automation.

In each case, we can quite readily establish where we stand today in relation to fulfillment of the requirements for ultimate automation. Somewhat less readily identified—and certainly more difficult to evaluate in terms of their implications for the future—are those factors which will tend to promote, and those factors which will tend to impede, our progress toward fulfillment of the requirements for ultimate automation.

Finally, it is desirable to examine the basic concept of ultimate automation, and suggest a new pattern of intellectual orientation toward the application of the techniques of automation.

MECHANICAL REQUIREMENTS OF ULTIMATE AUTOMATION

Ultimate automation, as we have defined it, calls for uninterrupted manufacture of acceptable products without human intervention. To meet that specification on a factory-wide basis, we must first apply ultimate automation to the invididual processes in the plant. Then we must integrate them in a co-ordinated system. Finally, we must apply a single overriding control. Of course, there may be several intermediate layers instead of just one. Schematically, the resulting control pattern will look very much like a company organization chart. Depending on the complexity of the processes involved, it may look like the chart of a one-plant small company; or it may look like the chart of a multiplant, multidivision, industrial giant.

At each stage, the required elements of control are the same; a closed-loop or feedback system is needed.

The commonest form of feedback system is, of course, the human being. He can "sense," through sight, feel, and so forth, what is going on. In his memory, he can store up information on optimum conditions in terms of his senses. When there is a difference between what is going on and what should be going on, his nervous system puts his muscles to work to effect a correction in the process.

Now, it's when the human being comes to making a correction in the process that we have to examine two possible approaches. Someone may have told him: "If the process error is exactly so-and-so, take thus-and-such action." That's simple. And if that's all that's required, then the entire feedback control can be provided mechanically.

But what if the specific process error has not been anticipated? At this point, our human being must begin to use his powers of reason and judgment. He faces an "original problem," and he must figure out an "original solution."

This is beyond the present limit of "mechanical brains," and hence represents the present limit of feedback control and of automation.

Let us be very clear as to just what is meant by "original problems." The mere fact that one problem involves different numbers from the preceding one does not make it original. Then the "method" of solving the two problems will be identical: no "ingenuity" is required. For that matter, a case probably can be made out for the proposition that there is no such thing as an "original problem." But any problem is "original" to a control system or to a mechanical brain unless it has been specifically anticipated, and the "instructions" for its solution engineered into the equipment.

Probably it would be possible to build a control device that would anticipate every possible process condition. As a practical matter, we know that somewhere a point is reached beyond which it is cheaper to employ human agents. At the moment, of course, the shoe is on the other foot. For most industrial applications, the cost of ultimate automation is high—very high—in relation to the present cost of human labor.

As a consequence, we see automation applied today primarily in two situations:

1 Where the "type of human labor required" is such that an adequate supply does not exist—at any price. Such applications are generally in connection with engineering, research, and design problems, rather than production processes. The mechanical elements of the problem-solving apparatus involved in the two situations are, however, identical.

2 Where the "nature of the process" is such that it is literally impossible for human beings to exercise adequate supervision and control. Production of radioisotopes and petro-

Contributed by the Management, Industrial Instruments and Regulators, Materials Handling, Safety, and Production Engineering Divisions, and Junior Committee, and presented at the Annual Meeting, New York, N. Y., November 30-December 5, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

leum refining are, perhaps, outstanding examples of such large-scale operations. Small-scale illustrations exist everywhere—starting at home with the escape valve on mother's pressure cooker and extending to the radar-controlled all-weather interceptor plane.

A third, and rapidly growing, area of applications of automation is where the quality requirements of the end product are tight. Maintaining fine tolerances—whether in size, weight, finish, chemical properties, or any other process variable—is a job for which feedback control is admirably suited. And it is here that automation shows to its greatest economic advantage.

No longer do we have a simple question of a high-priced piece of control equipment paying for itself solely by "eliminating" a worker or even several workers. By maintaining quality standards, the control equipment is now saving also the cost of scrapped material, the cost of rework, the cost of the extra equipment needed to produce ten units to get five good ones, and all of the overhead costs which are incurred in making bad units as well as in making good ones. The result is to bring automation not only within the realm of economic feasibility, but to make it almost a necessity for companies that must maintain tight quality standards in a competitive market. This is particularly true when the nature of the process involved is such that the control mechanism need be engineered to anticipate changes in relatively few process variables.

This, it would seem, is the big opportunity for automation in the near future. It is the area in which the economics of automation are most favorable, or at least most readily demonstrable—and right at the moment demonstrability is the biggest stumbling block to automation.

MANAGERIAL REQUIREMENTS OF ULTIMATE AUTOMATION

The prime requirement of management if we are to have ultimate automation is that management become convinced that it is an economically sound investment. Most managements are not yet so convinced.

The dollar cost of labor has risen so sharply in the past 20 years that management today is emphasizing reductions in labor cost almost to the exclusion of everything else. This is bringing a twofold result:

1 Substitution of machines for muscle jobs (which in itself is not automation) is increasing the demand for skilled workers and technicians, in proportion to our total work force, to the point where a "shortage of skills" is becoming one of our most acute problems. To a certain extent, it's a case of feedback control acting as a self-governor on unbalanced changes in demands for special types of labor.

2 Despite full employment in all but a few industries, some labor unions are beginning to protest against the advent of new machines that create "technological unemployment." More will be said about this later; it's enough to say here that management persistence in viewing automation as a "laborsaving" device is encouraging such attitudes by unions. It is somewhat ironic that the economic basis on which automation cannot alone succeed is the basis upon which it is most criticized.

But even where management is willing to look beyond possible laborsaving and assess the larger advantages of automation, many managers still remain unconvinced. Perhaps the most common complaint is this:

"These machines are so complicated I'd need a whole college full of engineering professors just to keep fixing all the things that go wrong. I know—you can put automatic monitors on automatic controls, but that's just one more piece of equipment to break down. I'd be bankrupt just from the maintenance cost."

That just plain isn't so. To be sure, automation will make maintenance more difficult. Higher skills, better organization, and—above all—more preventive maintenance will be needed. But the burden won't be killing.

For proof, management has only to look at the petroleum industry. It's highly automatic. Its maintenance problems are tremendously complicated. But its total labor cost as a percentage of sales is the lowest of any major industry in the history of the world.

This result has been achieved by concentrating on the reduction of total cost; and never mind which pocket the money comes from.

Let us take an example. The author knows of a chemical plant that had just about 1000 employees five years ago. The management decided on a complete modernization, plus a 50 per cent expansion in capacity. Today, the plant has almost exactly the same number of employees. But instead of 700 production workers and 300 maintenance men, there are now about 550 production workers and 450 maintenance men.

Despite far more complicated processes, machinery, and controls, the number of maintenance man-hours per unit of product has remained almost constant; actually, there has been a slight drop, because current production is more like 60 per cent above the old capacity.

Is the management of that plant worried because maintenance now "eats up" 45 per cent of total wages, instead of the 30 per cent previously? Not a bit. Because, despite a 35 per cent rise in hourly wage rates, and a 50 per cent increase in the cost of raw materials, this company's unit cost today is substantially lower than it was five years ago.

A little quick arithmetic will disclose that the total man-hours per unit dropped only about one third. That's not enough to offset the jump in hourly rates plus increased material costs. And that is precisely the point. The company figures that for every dollar saved by reducing the man-hour content of each unit, it saved at least three dollars through less production of substandard material, fewer customer complaints, better utilization of equipment, and elimination of overhead on "nonsalable" production.

There is one more "attitude" which will be required of management before we reach ultimate automation. This is a realization that automation is possible; that the nature of many processes and operations do not preclude automation.

The technical know-how of automation exists. The only question remaining for management is whether it is economically justified in a specific instance, and whether management is prepared to make certain "collateral changes" that will be necessary if the full benefit is to be gained. These collateral changes include a willingness to overhaul the very structure of management itself, because the typical management heirarchy we know today does not lend itself to supervision of an enterprise which has reached—or is approaching—ultimate automation.

The "line" organization of management we have today will be too slow and cumbersome. It provides for specialists, but it does not put them where they will be required by automation; it breaks up specialties into units or cells, instead of co-ordinating specialties as closely welded smoothly functioning teams. Further, the "line" organization breeds men who are equipped to manage a particular specialty; not men who are adept at co-ordinating the activities of specialists in many different fields.

We are fast approaching the time when the engineering executive—and very likely the top executive—will be an engineering "generalist." That is, he will be a specialist in

administration with enough background in many phases of engineering to be able to understand and work with engineering specialists in virtually every field.

This will pose a tricky problem for the management trying to develop future leaders: If an assignment as an engineering specialist is not the proper training ground for the future executive, what is? The problem will be one of spotting potential engineering generalists early enough to be able to move them around and thus prevent their becoming overly specialized. (Perhaps a mechanical "brain" can be developed to provide an infallible answer to this problem!)

The need for more specialization, higher skills, virtually a new kind of management organization takes us right over into the third area we want to examine.

SOCIO-ECONOMIC REQUIREMENTS OF ULTIMATE AUTOMATION

The question on almost everyone's lips seems to be this: "Will automation cause a disastrous economic revolution?"

Dr. Norbert Wiener of M.I.T. has said that the advent of electronic brains in industry will cause widespread unemployment Some people have estimated that the unemployment figure will run as high as 20 million. In the 1930's we saw the havoc wrought by 12,000,000 unemployed. The prospect of nearly twice that many out of work is not pleasant.

Now, the electronic brains of which Dr. Wiener speaks will not, of themselves, do any work. But they can become the control which makes practical the operation of the automation devices we have been discussing. The fact that the word mechanical is used by the author in connection with automatic control does not imply that he is not talking about electronic devices. "Mechanical" has been used merely as a convenient term to include mechanical, electrical, electromechanical, electronic, hydraulic, pneumatic, sonic, atomic, or any other medium of power transmission which can be made to convey intelligence.

The author disagrees with those who believe that automation will foster an economic cataclysm.

It is thought that continuation of two well-established historical trends, plus the existence of a very inefficient distribution system, will prevent it. Let's look at the last item first:

The apparently simple act of moving goods from the hands of the producer to the hands of the ultimate consumer is tremendously complicated, and places an almost fantastic drain on our manpower. Well over 2,000,000 people are employed full-time in long-distance moving of goods by rail, truck, boat, barge, pipe, and plant (and that figure is adjusted to make allowance for carriers that do double duty in moving passengers, whom we're not talking about). To that you must add all the people engaged in making local deliveries—from the retailer, warehouse, storage point, or depot to the individual consumer.

Then we have all the people engaged in running the retail and wholesale establishments themselves. Even if automation devices displaced all the bookkeepers and accountants, the figure would still exceed 5,000,000.

The list goes on almost endlessly. Then we have all the people engaged in providing personal services and entertainment—and the people who run hotels and motels, apartments, and restaurants.

Actually, we get a better perspective on the problem if we look at it from the other end. Production employment in manufacturing today is about 12,500,000—up about 4,000,000 from 1939. Yet our total employment since 1939 has risen from 45,000,000 to roughly 62,500,000—a gain of more than 17,000,000. In other words, in absolute numbers, we have had to add to our total employment at four times the rate we have had to add to our manufacturing employment in order to produce and distribute the present supply of goods.

Certainly the advent of automation is going to mean lower costs—that's the simple basis on which businessmen are buying or not buying new equipment. And those lower costs will mean more real purchasing power and therefore more goods produced—either through lower prices, or higher wages, or both. It's an "economic feedback control."

If ultimate automation of every major factory were to arrive in a short span of time, the dislocations would certainly be serious. But it's obvious that ultimate automation will not take place in every company on the same day—or the same year. So it can be expected with confidence that the "economic feedback control" within our competitive system will prevent major dislocations. We can, of course, mismanage ourselves into economic trouble, but the real cause won't be automation.

There are two other elements—historical trends, so-called—that will tend to keep the economy on an even keel as automation progresses:

1 With only occasional temporary setbacks, America has had a continually rising standard of living. As the trend continues, we will consume more goods per person. That, combined with a rising population, will provide a market physically capable of consuming virtually anything and everything even ultimate automation can produce.

2 Apart from two world wars and the present cold war, the work week has been getting progressively shorter. It was artificially shortened during the depression of the thirties, but after a rise in the second world war was back to less than 40 hours by 1950. Even today, it is little more than 40 hours, compared with 68 hours back in 1875, and over 50 hours a mere quarter-century ago.

As automation takes hold, a shortened work week will mean relatively little in the manufacturing industries. But just a slight drop in the work week in other industries will bring a sharp rise in the demand for workers. There is little on the horizon that promises to bring marked reductions in the number of man-hours required by nonmanufacturing industries (agriculture, however, may be a marked exception to that generalization).

An additional factor that will begin to play a definite part within the next decade is the growing number of pension plans with enforced retirement at age 65. That will tend to take people out of the job market. But it will be a mixed blessing, because pension status will mean a substantial reduction in purchasing power for most of these people.

At the other end of the age spectrum of the population, we find young people staying in school for more years. That means a smaller percentage of the total population who are job seekers. And the trend toward longer schooling will be accelerated not only by the socially inspired growth of universal education, but also by the demands of higher skill and higher education by industry.

Although it is a politically unpopular thing—for any party—the possibility of a universal military training law that would further delay entry of youngsters into the labor force by 18 to 36 months is not yet to be discounted entirely.

All of these factors would tend to lessen any dislocating consequences of automation.

This all leads to the question: "Well, what are we waiting for? You've said that there are no mechanical limits on automation; that there are many places where it is economically feasible; and that it won't cause disastrous technological unemployment. Why aren't people doing it?"

Perhaps the largest single answer to that question is a lack of realization that it can be done.

This lack of understanding is most pronounced among the men who manage industries making discrete units; that is, individual and distinct things such as machinery or machinery parts, utensils, and the like.

What keeps engineers and managers in the discrete-unit industries from making faster progress toward automatic production is a failure to conceive of their whole manufacturing process for things as essentially the same as the continuous flow of the chemical or petroleum industries. For example, they should remember that 50 years ago the chemical and oil industries, that we think of naturally today as continuous, were using strictly batch processes to turn out barrelfuls.

A specific example will make the point. Take powdered sulphur and liquid latex. We regard them as flow materials. But what happens if we look at them closely? The powdered sulphur is seen to be fine, individual grains of sulphur. And under an electron microscope, we can actually see the individual molecules in the latex. Now, these flow materials are really nothing but a great many things, or discrete units. To be sure, the discrete units are very small, and they are all identical. But they are nonetheless discrete units.

At this point, let's take a look at what we do to these things, in terms of manufacturing processes. To the latex, we add carbon black and some other chemical ingredients to make rubber. And that rubber, when viewed under an electron microscope, still has the same essential type of structure as the liquid latex—identifiable individual molecules. Only now the molecules are shaped somewhat differently and more widely separated by the presence of the fine particles of carbon black.

To a certain extent, what has taken place is analogous to a forging operation. We have changed the shape of the thing we were working with. And then we have inserted some shims between the forgings when we stacked them up for storage.

Now let's add the powdered sulphur. Process heat breaks up the sulphur into individual molecules. These, in effect, reach out and grab the rubber molecules, and hold them together in a tight bond. The rubber is now vulcanized, and it won't come apart except under extreme pressure.

Is that analogous to a manufacturing operation? It would seem to be, if we simply adjust our perspective to get both into the same scale.

The sulphur is nothing more or less than the welding rod, used to weld the forgings together.

Now let's take a look at another example. The giant catalytic crackers in the petroleum business are perhaps the most heavily instrumentized pieces of process equipment in the world.

But let's forget for a moment just how the cat cracker is used. Let's see if we can't define in the simplest and broadest possible terms just what it does. The function of the catalyst is to cause a material with which it comes in contact to "crack" into two identifiable and separable materials without itself being changed. To be sure, the catalyst in a cracker does sustain some "wear," but that is only because it's not a perfect catalyst; wear is not part of its intended function.

But isn't this also a good description of the function of a machine tool? The bit on the tool is the "catalyst" that separates one material—the raw stock—into two identifiable and separable materials—the chips or turnings and the finished stock.

To complete the analogy, some wear occurs on the tool bit—but only because it isn't perfect, and not because we want it to wear.

Furthermore, has the reader ever seen a photograph made through a microscope of what happens at the point of contact between a tool bit and the work surface? The bit doesn't really "cut" the material away, as suggested by the name cutting tools; it actually "cracks" the chip off the raw stock.

If we can make "cat-cracking "automatic in the oil industry, can't we do the same in the metalworking industry? We can if we realize that we can. After all, we've really done the harder-to-conceive job first in this matter of automatic production. We've engineered the automatic assembly of atoms we can't see before we've made comparable progress in automatic assembly of nuts and bolts and pieces of metal.

But it is believed the big turn has come in industrial thinking. The conception of automaticity and flow-processing in making "things" is fast gaining acceptance in industries and among managements where it was considered impractical only a few years ago. Furthermore, economic and social forces are working strongly in favor of automation.

The result is almost certain to be an era of rapid evolution and progress toward the highly automatic plant—the factory in which mechanization will supplant not only men's and women's muscle power, but also their routinized sensory perception.

Automation

THAT many of our nation's factories will some day be automatically controlled is a probability, if not certainty, which American industry must recognize and anticipate. This observation is made by the Council for Technological Advancement in a report on "Automatic Control and The Automatic Factory," one in a series of reports on economic and technological advancement in the United States. The Council is affiliated with the Machinery and Allied Products Institute.

The Council points out that major advances of far-reaching importance have been made recently in the development and use of automatic control. Present application is widespread and involves a growing diversity of control instruments. The applications of automatic control to such processing variables as pressure, temperature, flow, and level has already been transformed from laboratory experimentation into practical mass production. The numerically controlled milling machine undoubtedly foreshadows further applications in the metalworking industries. The application of devices which record measurements and perform the function of control are likewise steps toward the automatic or semiautomatic factory of the future, the report states.

Tomorrow's automatically controlled machines, according to the report, will be "guided without human intervention in response to a series of instructions previously recorded in numerical code on such media as cards, paper tape, magnetic tape, or film."

The Council points out that there has always been a need in short-run production industries for flexible machines capable of manufacturing small quantities of several different parts at low cost, as opposed to special-purpose machines used in mass-production industries that are designed to produce a single or relatively few parts. Numerically controlled machines, it is stated, give great promise of breaking this bottleneck.

As presently envisioned by the Council, the principal benefits of automatic control to our nation's production will be (1) less down time of productive facilities since machines will be switched from one job to another without the need of making costly, time-consuming mechanical adjustments, (2) less work in process will be spoiled, and (3) production per worker will increase, which, in the final analysis, is the only way the United States, as a nation, can raise its standard of living.

Copies of "Automatic Control and The Automatic Factory" may be obtained by writing the Council for Technological Advancement, 120 South La Salle Street, Chicago 3, Ill.

THE ASME BOILER CODE

VII Revisions and Special Committees—1932–1935

By ARTHUR M. GREENE, JR.

PRINCETON UNIVERSITY, PRINCETON, N. J., HONORARY MEMBER ASME

THE Great Period described in chapter 6 which covered the recognition of fusion welding and the enlargement and clarification of many sections of the Code led at once to improvements in the first rules for fusion welding and adjustments of paragraphs of one section and even between the different sections of the Code. The revisions made at eight of the nine committee meetings of 1932 resulted in the 1932 editions of Section IV, Low-Pressure Heating Boilers, Section VII. Rules for Care of Power Boilers, and Section VIII, the Unfired Pressure Vessel Code, by means of addenda approved by the ASME Council. These revisions and those of the eight sessions of 1933 enabled the Boiler Code Committee to issue the 1933 editions of Section I, Power Boilers; Section II, Material Specifications; and Section VII, Rules for Care. In 1935 the many revisions made during the four years resulted in new sections as well as a single volume of 609 pages and an Index of 30 additional pages which covered all the sections of the Code.

During this period the minutes of the Committee show that on an average at least one Special Committee was appointed at each session of the Boiler Code Committee to formulate a reply or to rephrase one, to decide on some action, or to ascertain needed data. Throughout the period, as well as those of earlier and later years, the Executive Committee, under the chairmanship of Dr. D. S. Jacobus, decided many questions referred to it and made many suggestions for Committee action or procedure. The accessibility of the members of the Executive Committee, their interest in the work of the Boiler Code, and their knowledge, together with the efficiency and devotion of the Acting Secretary, Miss M. Jurist, made the work of the Boiler Code Committee possible and effective at all times of emergency.

During the four years 1932–1935 the Committee held nine meetings per year with an average attendance of 13 committee members, 3 members of the Conference Committee, 5 noncode members of Subcommittees, and seven guests. One hundred and twelve new cases were listed, Cases Nos. 705 to No. 811, an average of 28 per year.

The addenda to the editions of the Code Sections will now be discussed and then some of the Committee activities which produced the changes will be reported.

1932 EDITIONS,

SECTION VIII, UNFIRED PRESSURE VESSELS

The 1932 edition of Section VIII, Unfired Pressure Vessels, contained in Par. U-1 a new description of the vessels to which the section should apply and also stated that the specific provisions of Section I of the Code should be mandatory where no definite rules of construction were to be found in Section VIII. Some additions were made regarding the marking of safety valves, and Par. U-12 now provided that other materials than those specified might be submitted for consideration whenever such material became available in the development of the art of pressure-vessel construction. This provision was also made in Par. U-71 (*c*) as in the 1931 edition.

The need of an x-ray examination of the joint between a dome flange and the vessel was eliminated in cases where the welding was in accordance with the rules applying to the particular class of vessel to which the dome was attached. The reinforcement of openings in dished heads of a segment of a sphere was to be formed in accordance with the new rules of Par. U-59, which considered the head as a shell of the diameter of the head, and new rules were given for the size of openings which needed no reinforcement. These rules had been prepared by the Special Committee on Unreinforced Openings.

Par. U-59, Nozzle Openings, was reworded, enlarged, and contained portions of other paragraphs of the 1931 edition. New charts replaced old formulas for the size of unreinforced openings. New divisions on expanded connections, studded connections, reinforced openings, riveted connections, forge-welded connections, fusion-welded connections, and brazing were found in Par. U-59 as well as new figures for nozzle fittings and a rearranged and more extensive illustration of some acceptable types of fusion-welded nozzle connections.

The portion, General Requirements, now provided for the permanent marking of each vessel of plates less than $^1/_4$ in. thick in some permanent form to identify the heat from which the sheet had been rolled. Par. U-66 on stamping was enlarged.

The portion, Rules for the Fusion Process of Welding, was changed in only a few places. When several vessels were welded in succession using metal within a range of $^1/_4$ in., each 200 ft of longitudinal and circumferential seam might be considered as the equivalent of one vessel and only the test plates required by the two earlier sections had to be made, provided they were welded in the same way as the joints in question. The value of the working stress ($S \times E$) of the third class of vessels was given as 5600 psi for thickness of plate less than $^1/_4$ in. and for $^1/_4$ to $^3/_8$ in. as 7000 psi.

The Rules for Forge Welding were changed to allow firebox-quality steel to be welded and provided that stress-relieving be done according to an earlier Par. U-76. The Rules for Brazing were changed to increase the maximum working stress ($S \times E$) to 9900 psi from 8550 psi.

All material specifications of this section in the 1931 edition were transferred from Section VIII to Section II and all references to materials in this section were made by the specification numbers of Section II of the Code.

The Appendix now contained, Pars. UA-1 to UA-8, Standard Practice for Making Hydrostatic Tests to Determine the Maximum Working Pressure and seven new pages of samples of methods, Computations of Openings in Shells, Pars. UA-10 to UA-15. Fig. UA-1 giving four forms of nozzles and one forged bushing to be welded were added for these computations.

This section was signed by E. R. Fish,[1] chairman, C. A. Adams, W. H. Boehm,[1] C. E. Bronson,[1] R. E. Cecil,[1] Paul Diserens, A. W. Limot, Jr., H. S. Smith, and D. B. Wesstrom

[1] Member of Boiler Code Committee.

Chapter 7 of a history of the ASME Boiler Code, prepared for the Boiler Code Committee of The American Society of Mechanical Engineers. Other chapters appeared in MECHANICAL ENGINEERING, July, August, September, November, and December, 1952, and February, 1953.

Messrs. Adams, Limot, Smith, and Wesstrom had been added to the Committee.

SECTION IV, LOW-PRESSURE HEATING BOILERS

The 1932 edition of Section IV, Low-Pressure Heating Boilers, contained only minor changes and rewordings. Par. H-35 provided that only where the external width exceeded 36 in. on a wet-bottom type of boiler must there be not less than 12 in. between the bottom of the boiler and the floor line. When the width is 36 in. or less the distance should not be less than 6 in. and when the wet bottom was not further from the outer edge than 12 in. this was reduced to not less than 4 in. An addition to Par. H-66 provided for shop inspection of boilers fabricated by fusion welding to be conducted by qualified inspectors during construction and after completion. The material specifications appearing in the 1931 edition of Section IV were transferred to Section II, Material Specifications.

This revision was signed by Frank B. Howell,[1] chairman, W. H. Boehm,[1] Charles E. Gorton,[1] F. W. Herendeen, J. W. Lockett, M. F. Moore,[1] W. E. Stark, and J. W. Turner.

Messrs. Herendeen and Lockett were new members and W. A. Nevin had resigned.

SECTION VII, RULES FOR CARE OF POWER BOILERS

The 1932 edition of Section VII, Suggested Rules for Care of Power Boilers, was the same as that of 1927 except for the change in Par. CA-5 dealing with caustic embrittlement. It will be recalled that in the first draft of the Rules, objections to Par. CA-5 by one water-conditioning company were so strenuous that Par. CA-5 was altered in the first printing in 1927. The data now collected by the Subcommittee showed so clearly the phenomenon called caustic embrittlement that a revision was prepared which included a description of intercrystalline cracks occurring only in joints and seams where dissolved solids of the boiler water might be great. These cracks were generally attributed to the effect of caustic soda on the highly stressed metal. Then followed instructions for preventing embrittlement. Reference was made to Bulletin No. 216 of the Engineering Experiment Station, University of Illinois; "Embrittlement in Boilers," 1930. Although the suggested revision to the 1927 edition was presented in 1931 it was not acted upon until it was again presented on Feb. 19, 1932. This Section VII contained Pars. C-1 to C-341 (66 pages) and an appendix, Par. CA-1 to CA-27 (14 pages) with the same titles as in the 1927 edition.

It was signed by F. M. Gibson, chairman, V. M. Frost,[1] J. R. Gill, J. L. Hunter, H. J. Kerr, W. H. Larkin, Jr., S. T. Powell, Cyrus W. Rice, H. J. Scott, N. Stahl and F. G. Straub.

Messrs. Hunter, Kerr, Powell, and Straub were new members. E. G. Bailey, W. S. Deman, J. W. Hays, and J. S. Shoemaker had resigned and S. F. Jeter had died.

EDITION OF 1933

Section I, Power Boilers, Section II, Material Specifications, the Appendix, and Section VI, Rules for Inspection of Materials and Steam Boilers, were published in one volume from addenda issued since their last printing. These made a book of 314 pages of which 22 constituted the index.

The only change made in Section VI was the new Par. I-61 calling for inspection reports on forms given at the end of the section. Form A was to be used upon the first internal inspection of any boiler by all inspectors and thereafter Form B was to be used for subsequent external inspection and Form C for subsequent internal inspection by all inspectors unless changes and repairs warranted the filing of a new Form A report. There were 28 lines of data to be filled in on Form A, 14 on Form B, and 17 on Form C. The inspector was to certify Forms A and C, while the signature only was required on Form B. These data were sufficient to check the fulfillment of Code requirements and to give the history and ownership of the vessel.

The Subcommittee on Inspection was composed of C. A. Collins, chairman, S. H. Barnum, L. E. Connelly, C. E. Gorton,[1] F. W. Herendeen, and James Partington.[1]

Section II was brought into agreement with changes made in the latest ASTM Specifications since 1921, and Specification S-25 for Open-Hearth Iron Plates which was added had been approved in 1930.

The principal changes in the 1933 edition of Section I, Power Boilers, were: permission to use steel pipe of S-18 or steel tubes of S-17 for boiler drums; a table of the working stresses in steam piping of the various materials of Section II when used at different temperatures and its use in a new formula for the working pressure in steam pipe. The table for the working pressure of copper tubes for fire-tube or water-tube boilers was new. Additions and changes were made in Par. P-102(*i*) Nondestructive Tests.

These changes in Par. P-102(*i*) covered increase of metal thickness to be x-rayed from $2^1/_2$ in. to $4^1/_4$ in. Any manufacturer desiring to weld a thickness greater than $4^1/_4$ in. must first demonstrate that he had produced sound welds in plates not less than $3^1/_2$ in. thickness. Gamma rays as well as x rays were permitted for making radiographs. The use of thickness gages or penetrameters for detecting flaws or defects of a thickness equal to or greater than 2 per cent of the thickness of the weld was described. This revision also gave the method of determining the position of the film relative to the face of the weld dependent on the position of the source of radiation. Identification markers, data needed by the inspectors, and the requirements for satisfactory welds were covered in detail. It was required that the markers should be of such form and so placed that measurements from the radiographs could be used to locate defects.

In addition to these changes, words, clauses, or even paragraphs were inserted to make the rules clearer or to care for the interpretation given in the replies to the inquiries of cases.

This edition of Section I was signed by the Boiler Code Committee, including R. E. Cecil, and A. C. Weigel as new members. E. F. Miller and F. W. Dean, former members, became honorary members, on Oct. 22, 1932. Le Roy Mikels resigned in January, 1931. Maine and the District of Columbia had approved the Boiler Code while the names of Missouri and Evanston, Ill., were omitted, so that the list of the Conference Committee now contained 36 names.

The 1933 edition of Section VII, Suggested Rules for the Care of Power Boilers, was a reprint of the 1932 edition with the same members of the Subcommittee.

EDITION OF 1934

Although an edition of Section VIII, Unfired Pressure Vessels, had been issued in 1932, some experiments and studies extending over several years had been completed by 1934 and an edition of that year was published to make the results available to industry and the profession. These were the new Rules for Flat Heads, Rules for Vessels Subjected to External Pressure, and Rules for Bolted Flanged Connections.

Some of the other changes were as follows: the requirement for rivet tension of not more than 7200 psi for the connection of manhole frames and dome flanges; in Par. U-33(*b*) the use of the inner diameter of the thinnest portion of the shell in applying the rules for butt joints; the classification of welds by the numbers of the paragraphs, U-68, U-69, and U-70, used in design rather than the class numbers 1, 2 and 3; the extension

[1] Member of Boiler Code Committee.

of the interval of time between the tests of welding operators from six months to one year when they were regularly employed on production work embracing the same process and type of welding; and finally, the local stress-relief of nozzles or welded attachments. One new form of welded head attachment was added to Fig. U-18 and the stress-relief of nozzles was added to Par. U-76.

Par. U-68(*i*), Nondestructive Tests, was reworded so as to correspond with Par. P-102(*i*). Radiographs by gamma rays were recognized as well as those by x rays and the limit of thickness of weld for the use of x-ray or gamma-ray method of examination was increased from $2^1/_2$ to $4^1/_4$ in. Details of the use of the penetrameter or thickness gage were given and also rules for the minimum distance from the source of radiation to the back of the weld for different thickness of metal. New statements were made relating to the qualities of the radiographs and the data recorded on them. In place of the Fig. U-11 showing radiographs of ideal, acceptable, and unacceptable welds of the Code, this edition required comparison with a standard set of radiographs to be purchased from the Boiler Code Committee. Development of the art of x-ray examination of welds during this active two years made these changes possible.

A new definition of lethal substances was added in the footnotes to Pars. U-69 and U-70.

The rules for forge welding, for brazing, and for enameled vessels were not changed.

The short section Par. U-39, Flat Heads, of 1932 was enlarged in the 1934 edition to a three-page section as the results of the extensive study of flatheads by a special committee of which D. B. Wesstrom was chairman. In this new formulation, the constant 0.162 of the formula for thickness was changed to *C* for which five values were given to suit five special conditions. Fig. U-2 gave eight acceptable types of flat heads and covers.

The first four of the 19 numbered paragraphs of the new Rules for Vessels Subjected to External Pressure referred to the materials to be used; the working pressure, defined as the maximum pressure difference between the pressures on the outside and inside of such vessels; the minimum pressure of design; and the use of Fig. U-20. This figure was included for the determination of thickness of shells and its use was explained in Par. U-124 for the different structures of Fig. U-22. Out-of-roundness and its limits were explained in Par. U-125 and by charts, Figs. U-25 and U-24. Stiffening rings were discussed and described in Pars. U-126 to U-128 with charts, Figs. U-26 and U-27. The rules for supports, heads, longitudinal and circumferential joints, and nozzle openings were covered in Pars. U-133 to U-138.

The section on vessels subjected to external pressure was the result of an investigation made under the direction of the Research Committee of the ASME and at the Naval Experiment Station as described later.

The Rules for Bolted Flanged Connections were placed in the Appendix and designated Pars. UA-16 to UA-22. These paragraphs covered the scope of the rules, the materials, the working stresses at different temperatures of various grades of material, bolting, flange design, and hub design. Formulas and charts were included to fit the various forms of flanges and hubs. These rules also resulted from the extensive study of a special committee.

This edition of Section VIII was signed by E. R. Fish,[1] chairman, C. A. Adams,[1] W. H. Boehm,[1] C. E. Bronson, R. E. Cecil,[1] Paul Diserens, A. W. Limot, H. S. Smith, and D. B. Wesstrom.

[1] Member of Boiler Code Committee.

CODES OF 1935

SECTION I, POWER BOILERS

The 1935 edition of Section I, Power Boilers, contained many changes brought about by the replies to inquiries. On several occasions V. M. Frost brought in prepared alterations or additions to assure agreement between interpretations and the Code. As a result of this work, Mr. Frost became the Chairman of the Special Committee on Coordination upon its establishment. The minutes of the Boiler Code Committee indicate the great care that was given to the addenda. At times a paragraph was discussed at consecutive meetings or even at those months apart by reopening cases. For instance Par. P-2 was altered to mention the newly approved steels of specification S-26 and S-27 while Par. P-9 recognized nonferrous metals and called attention to the requirements of specifications S-18, S-19, S-23, and S-24. The limitation of temperature and pressure on parts made of cast iron and malleable iron were definitely related to the only types of these metals authorized and described in S-13 and S-15. In P-15 the crushing strength of alloy steel was recognized and in the succeeding paragraph the shearing strengths of two grades of alloy steel for rivets appeared with those for wrought iron and steel. These give examples of a large number of minor changes.

In Par. P-102(*e*) attention was called to the fact that the test of a welded-joint specimen was for the purpose of testing the weld and not the plate, and later two additions were made to the gages shown in Fig. P-4, Details of Thickness Gages or Penetrameters. The job number and identification of the drum and seam as well as that of the manufacturer was required to be plainly indicated on each film.

The formula for the flathead thickness was changed by substituting a constant *C* for the constant 0.162. The various values of this constant *C* (0.162, 0.75, 0.50, 0.30, and 0.25) for six different sets of conditions were given on three pages together with 12 illustrations of acceptable types of heads. These changes as well as the large additions on openings in the 1933 edition were prepared by the Subcommittees on Heads and Openings (same as Par. U-39 of Section VIII of Code).

A few changes were made to the division on Safety Valves on account of the new standard for flanges and for the attachment of safety valves to superheaters.

The section on fittings and attachments was changed to bring the Code into agreement with the requirements of the tables of the American Standards Association given in the Appendix as to dimensions and maximum allowable working pressure and temperature. These changes also provide for fittings below the water line, on feedwater and blow-off lines and of other materials of the Code different from those of the tables.

A major addition was made to Par. P-325 permitting fusion-welding of lugs, hangers, and brackets when of the same size as those which could have been riveted if made of Code materials when attached by fusion welding by the requirements of Pars. P-101 to P-111, inclusive, with stress relieving and the use of fillet welds along the entire periphery of contact edges. The method of computing stress was given.

NEW MEMBERS OF BOILER CODE COMMITTEE

In the list of the Members of the Boiler Code Committee, the names of C. A. Adams, H. C. Boardman, A. J. Ely, W. G. Humpton, and Walter Samans appear as new members.

William F. Durand, M. F. Moore, and C. L. Warwick had retired since 1933.

As North Carolina, Evanston, Ill., and Houston, Texas, had adopted the Code, the Conference Committee now consisted of 40 members.

SECTION II, MATERIAL SPECIFICATIONS

Section II, Material Specifications (1935), had been altered by using the last editions of a number of the ASTM Specifications and by the addition of five new specifications. These were: S-26, for High-Tensile-Strength Carbon-Steel Plates for Pressure Vessels (plates 2 in. and under in thickness, ASTM A-149–33T); S-27, for High Tensile Carbon Steel Plates for Fusion Welding (plates over 2 in. and up to and including 4 in. in thickness, A-150–33T); S-28, for Chrome-Manganese Silicon Alloy-Steel Boiler Plate; S-29, for Seamless 70–30 Brass Condenser Tubes and Ferrule Stock (ASTM B-55–33); S-30, for Seamless Muntz-Metal Condenser Tubes and Ferrule Stock (ASTM B36–33); and S-31, for Seamless Admiralty Condenser Tubes and Ferrule Stock (ASTM B44–33). In the foregoing list each but one was taken from ASTM Specification. Of the 31 specifications, 24 were identical with ASTM specifications, one in close agreement, two based upon ASTM, and four with no counterpart among the specifications adopted by the ASTM.

The Subcommittee on Material Specifications consisted of three conferring committees:

From ASME, P. R. Cassidy,[1] chairman, A. M. Greene, Jr.,[1] J. O. Leech,[1] and P. J. Smith.

From ASTM, C. L. Warwick,[1] chairman, E. J. Edwards, and C. F. W. Rys.

From AASM, J. O. Leech[1], chairman, E. F. Kennedy, and A. D. Peace.

SECTION III, BOILERS OF LOCOMOTIVES

The 1935 edition of Section III, Boilers of Locomotives, was identical with those of 1927 and 1931 except for the recognition of the acceptability of other steels for fabrication in Pars. L-2, L-3, and L-5, and some slight enlarging of Par. L-53 on holes for rivets. Fusion-welding of barrels had not been incorporated in this section although the use of fusion welding was recognized in cases where the load was carried by other construction as in the Locomotive Boiler Code from 1927 and the other sections of the Code of earlier years. Of course in this 1935 edition the stamp of the clover leaf contained the letter L to designate the section under which the boiler was inspected. This stamp and the data sheet were to be considered as a guarantee by the manufacturer that he had complied with all the requirements of this Section of the ASME Code by an addendum to Par. L-82 of this 1935 edition.

This Section of the 1935 edition was signed by James Partington,[1] chairman, F. H. Clark, J. M. Hall, and H. B. Oatley.[1]

F. H. Clark had been reappointed to the Subcommittee on his return from China and J. M. Hall had replaced A. G. Pack.

SECTION IV, LOW-PRESSURE HEATING BOILERS

The principal changes in the 1935 edition of Section IV, Low-Pressure Heating Boilers, were those in Pars. H-64 and H-117, Low Water Fuel Cut-Off. These were now entitled "Automatic Low Water Fuel Cut-Off and/or Water Feeding Device." These paragraphs were increased to cover construction, location, attachment, operation, flushing, and draining. Section 1, Steel Plate Boilers, Pars. H-1 to H-83, of this Code was altered to determine the equivalent diameter or width of shell for a noncylindrical boiler in computing the minimum allowable thickness of shell plates. In Par. H-28 a paragraph was added on the minimum size of firedoor openings. An addition to Par. H-39 gave details regarding open and closed expansion tanks. The attachment of seals to safety valves and the positive lifting of diaphragm water relief valves were some of the alterations regarding such appliances. Changes in Pars. H-69 to H-83, Fusion-Welded Boilers, were made for clarification.

[1] Member of Boiler Code Committee.

Section 2, Cast Iron Boilers, Pars. H-84 to H-118, contained a large addition to H-92 providing for expansion tanks and giving a table of the sizes of such to care for different amounts of equivalent direct radiation from 350 to 2400 sq ft. The same changes were made in this section as those for corresponding paragraphs of Section 1, Steel Plate Boilers.

Section IV was signed by A. H. Howell,[1] chairman, W. H. Boehm,[1] C. S. Bronson, J. A. Darts, C. E. Gorton,[1] F. W. Herendeen, W. E. Stack, and J. W. Turner.

Messrs. Bronson and Darts had been added to the Committee replacing M. F. Moore and J. W. Lockett.

SECTION V, MINIATURE BOILERS

The 1935 edition of Section V, Miniature Boilers, differed from the 1931 edition in that an appendix, Pars. MA-1 to MA-4, Test Requirements for Welded Joints, was added. This appendix was the same as Par. U-69(*b*) of Section VIII of 1935 after eliminating from it the first three paragraphs and the last paragraph on stamping. The first three paragraphs related to the efficiency of the unfired pressure vessels of Par. U-69. A qualification test sheet for welding operators was also included.

Three paragraphs were added to Par. M-4 describing the materials which could be welded, the testing of welding operators, and the conformance of the welded joints to the requirements of the Power Boiler Code or the Appendix Pars. MA-1 to MA-4. The efficiency of these joints was fixed at 80 per cent. A sentence was added to Par. M-14 to provide for bulls-eye glasses to replace water glasses on small steam generators of a closed system. For a closed system the requirements of a stop valve on a miniature steam boiler with a receiver was eliminated by addition of a clause to Par. M-17. In requiring the stamp using the letter M within the clover leaf, this Section, Par. M-20 stated that the data sheet and stamp should be a guarantee that the manufacturer had complied with all the requirements of the ASME Boiler Code.

This edition was signed by C. E. Gorton,[1] chairman, James Partington,[1] vice-chairman, E. R. Fish,[1] W. H. Furman, C. A. Luck, C. O. Myers,[1] and C. W. Obert.[1]

E. R. Fish, G. A. Luck, and C. O. Myers had been added to replace S. F. Jeter and W. L. Eales (deceased).

SECTIONS VI AND VII, RULES FOR INSPECTION OF MATERIALS AND SUGGESTED RULES FOR CARE OF POWER BOILERS

Section VI, Rules for Inspection, of this 1935 edition had not been altered from the 1933 printing and the same was true of Section VII, Suggested Rules for the Care of Power Boilers. This later was submitted by the same Committee signing the 1933 issue, but William Ferguson had been added to the Subcommittee for Section VI.

SECTION VIII, UNFIRED PRESSURE VESSELS

Although an edition of Section VIII, Unfired Pressure Vessels, had been issued in 1934, the addenda of the year were sufficient to justify a 1935 edition for publication with the other Sections which had been brought up to date. This would enable the Committee to add the Rules of Electric-Resistance Butt Welding which had been completed as a result of inquiries and hearings over a number of years.

The addenda used included provisions for threading and expanding nonferrous tubes into unfired pressure vessels, the limitations of the stress on rivets in dome flanges and manhole frames to 7200 psi when the thickness was $^7/_8$ in. or less, the reinforcement of openings in ellipsoidal heads, the pressure for hydrostatic tests of vessels to be used in service at temperatures above 700 F, and the rules for inspection of vessels made up of parts fabricated in different shops.

Par. U-68(*i*), Nondestructive Tests, was changed by providing that although stress relieving was required before radiographing the first 4¼ in. of a thick weld, the thicker finished weld beyond the limit of the x ray must be stress-relieved on completion.

The Sections on forge welding, brazing, enameled vessels, and vessels under external pressure were unchanged.

Credit for material added for corrosion in figuring strength was eliminated and permission to use the symbol meant that the manufacturer agreed that the vessel was built in full accordance with the Code. The maximum allowable temperature was made an added item to the stamping required on the vessel.

It is to be noted that in the enlarged Par. U-72, Preparation for Welding, flame cutting of plates was permitted if the carbon content did not exceed 0.35 per cent and the operation was carried out in a given manner.

To the section on Flat Heads which had been altered and enlarged in 1934, three new categories fixing the value of the constant *C* of the formula included and four additional figures showing the types of acceptable forms of flatheads by welds, threads, or rings were added to Fig. U-2.

The new Rules for Electric-Resistance Butt Welding consisted of five numbered paragraphs. Par. U-110 defined the metal of the parts of the vessel to be welded to be of the quality of the steel-plates for forge welding in S-2. Par. U-111 required that where the entire area was welded simultaneously without the introduction of extraneous metal the maximum allowable working stress should be 8000 psi. The weld should be annealed, preferably before removal from welding machine. Par. U-112 provided for progressive continuous welding over the entire length with plates not over 0.15 in. in thickness with an offset of the edges less than 60 per cent of the plate thickness. The contact edges of the plate and electrical contact point in this method must be cleaned to be free from scale, oxide, or grease.

Par. U-113 provided that the working stress of the vessel must be reduced to values shown in U-4 when the temperature in use exceeded 700 F.

The Appendix contained the Standard Practice for Making Hydrostatic Tests on a Pressure Part to Determine the Maximum Allowable Pressure and the sample methods of computation of openings in shells of the 1934 edition. The Rules for Bolted Flanged Connections were enlarged and Table UA-1, Maximum Allowable Design Stress for Bolted Flange Connections, was altered slightly in a number of places.

The new Manufacturers Partial Data Report was added at the end of the Appendix.

Section VIII was signed by E. R. Fish,[1] chairman, C. A. Adams,[1] W. H. Boehm,[1] C. E. Bronson, R. E. Cecil,[1] Paul Diserens, A. W. Limot, H. S. Smith, and D. B. Wesstrom.[1]

In the 1935 volume the subcommittees were listed with the names of members. There were ten numbers on the Subcommittee on Material Specification, four on Locomotive Boilers, eight on Heating Boilers, seven on Miniature Boilers, seven on Rules of Inspection, eleven on Care of Steam Boilers, nine on Unfired Pressure Vessels, seventeen on Welding, and eight on Special Design.

These eight sections and appendix made such a large volume (642 pages) that future editions have been issued in separate sections although placed at times within a special binder.

BUTT WELDING

During this period Pars. U-110 to U-114, Rules for Electric-Resistance Butt Welding, were added to the 1935 edition of Section VIII on March 15, 1935. These could be applied to the various methods of butt welding which were brought before the Boiler Code Committee during the previous period as mentioned in the foregoing chapter. These paragraphs covered the principles which might be used by any of these methods to produce welds that would warrant recognition in the ASME Boiler Code.

The other matters which follow give some idea of the activities of the Committee in making the codes more effective in producing safe and dependable structures.

RADIOGRAPHS

The first rules for fusion welding and classifications 1, 2, and 3 led in 1932 to the formation of a Class One Welding Association, made up of those manufacturing vessels for unlimited use requiring the x-ray examination of welds.

At the first meeting of the period, Jan. 15, 1932, a written statement was presented from L. C. Cockburn of the Fisher Body Corporation of Detroit, Mich., describing the x-ray examinations and tests of the welds on fusion-welded boiler drums. The x-ray examination of the circumferential seams of a drum demonstrated the effectiveness of this method of disclosing defects and locating them. By using permanent marks on the drum with lead numbers placed over them it was possible, by means of the film, to spot the locations as well as the size of defects. In all cases, the size of the defect was slightly exaggerated in the radiograph when it was uncovered by chipping. In a case of one radiograph certain indicated small defects were not chipped out and filled up by welding while others were properly welded. A new x-ray film still showed the unfilled cavities while those which had been filled were no longer indicated.

These tests indicated the advisability of using x-rays on the test specimen called for by the Code to determine strength and to test the welder.

These investigations suggested the need of amplified provision for stress relieving, with time limits, as some tests with specimens heated to the same temperature but with different rates of cooling showed different physical characteristics. With 1200 F for three hours and slow cooling the breaking strength of the plate was 58,700 psi and 57,750 psi in the all weld metal, while with 1200 F for two hours and faster cooling the breaking stress in the plate and weld was 62,650 psi and 63,600 psi in the all weld metal. The elongation in 2 in. was 34.4 per cent in the first case and 29.65 per cent in the second. These indicated that for this one-inch plate the shorter time of cooling resulted in greater strength but less elasticity.

A communication from Henry Vogt Machine Company, Louisville, Ky., on improvements to the requirement for radiographs by gamma rays and better stress relieving was referred on June 23, 1932, to the Special Committee on Standardization of X-ray Films for consideration and report. At a later meeting (Oct. 23, 1932) this Committee reported that it had adopted the suggested names "gammagraphs" for films from gamma rays and "exographs" for those from x rays in Par. P-102(*i*) while the general term "radiograph" would be used for either. The Committee had considered the question of quantitatively evaluating the degree of porosity shown in the radiographs but so far had not evolved any practical economic method and had concluded that the only satisfactory way of adjudging acceptability or rejection of porous welds was by direct comparison with standard radiographs showing varying degrees of porosity. To secure such sets a number of radiographs were to be obtained from manufacturers of fusion-welded vessels showing these various amounts and distribution of porosity and indicating the borderline conditions between acceptable and nonacceptable radiographs. Reproductions of these on films would be made by the Boiler Code Committee for sale to

[1] Member of Boiler Code Committee.

manufacturers and inspectors. The X-ray Committee also stated that it had recommended that the maximum distance from the film to the nearest surface of the welded seam be 1 in. It had also recommended that "monitor strips" be placed on the x-ray tube side of the welded seam to determine the proper penetration through thicker weld metal.

The report of the Subcommittee on X-ray Examinations, C. A. Adams, chairman, W. D. Halsey, and J. C. Hodge, made at the meeting of Oct. 23, 1932, approved the nondestructive test methods and provided for gamma rays, the increased thickness of plates to be x-rayed to 4 or $4^1/_2$ in., and the use of thickness gages to determine proper penetration of the welded seam by the radiating energy and for the distance from the target to the weld. It also provided for acceptable and nonacceptable porosity by the use of standard films.

The report discussed in detail the form and location of the thickness gage as well as the determination of the distance of the target from the weld and the weld to the film. The results of extensive tests on distortion of the image resulting from the positions of the tube, the plates, and the film were given in the report which acknowledged the assistance of R. E. Hille of the Babcock and Wilcox Company in performing many of the experiments mentioned in it.

The report stated that cracks in completed welds, elongated slag bodies, and loosely connected voids along the walls of the joints were easily interpreted in the radiographs and described quantitatively, but it was impossible to define quantitatively the degree of porosity shown on the radiograph which would represent an acceptable limit. Hence a set of standard comparison plates was suggested, but discarded. The Committee made radiographs of artificial blowholes but these were unsatisfactory. The Committee concluded that the only method was to secure a number of x-ray films from manufacturers of fusion-welded vessels as obtained in normal operation for borderline cases and that the Boiler Code Committee and its x-ray subcommittee should fix those which were deemed inacceptable, including one which was decidedly not acceptable.

The report also recommended that the radiographs be free from excessive exposure and developing defects such as fogging due to secondary radiation, light exposure during handling or over development, and water marks, developing stains, and marking from defective interfering screens.

The report closed with the revision of Par. P-102(*i*) which was included in the 1933 edition of this Section of the Code.

At the meeting of Feb. 16, 1933, the Boiler Code Committee approved the recommendation of its Subcommittee on Welding that the time of making the radiograph should be at the discretion of the manufacturer after the completion of the welding since the radiograph might indicate defects requiring additional welding, further radiographs would be required. When the weld was satisfactory the joint could be stress-relieved.

On May 26, 1933, the Special Committee on X-ray Requirements, C. A. Adams, chairman, reported on the use of sensitive x-ray paper by the St. John X-Ray Service Corporation for which speed, proper contrast, and reduced cost were claimed as well as the ability to produce two radiographs simultaneously. The Special Committee made no suggestion for changes in the Code until more comprehensive evidence of satisfactory use of this x-ray paper should be available.

The use of x-ray paper had been discussed at a meeting of the Class One Welding Association following a discussion with the Joint API-ASME Code Committee and the Association advised the Committee at its meeting of Feb. 16, 1934, that this paper had not yet proved itself capable of replacing x-ray films for the radiographic examination of welds.

The Committee also reported that it did not have sufficient data to determine the relative value of the 2 per cent markers and the more expensive penetrameters although it believed the latter to be distinctly superior.

It also justified the minimum distance of 36 in. and 38 in. from the radiation source to weld for wall thicknesses of 3 in. and 4 in., respectively, unless shorter films were used requiring a greater number of exposures and expressed some doubt as to the need for retaining radiographs for 10 years.

The objections to the use of gamma rays were not approved as gammagraphs must be used to examine very heavy sections.

On Oct. 19, 1934, the Special Committee announced that in collaboration with the Class One Welding Association it had selected four standard films covering the thickness ranges $^1/_4$ in. to $^3/_4$ in., $^3/_4$ in. to $1^1/_4$ in., $1^1/_4$ in. to $1^3/_4$ in. The first three indicated acceptable porosity and the fourth an unacceptable amount for $1^1/_4$ in. to $1^3/_4$ in.

The Ferrous Magnetic Corporation's method of testing Class II welded joints was reported by Mr. Partington on Oct. 20, 1933. This was similar to that shown in 1931. Although progress had been made, the indications were interpreted with difficulty. The Committee expected to receive information of tests made at the Naval Experiment Station at Annapolis, Md.

In consideration of the matter of plate thickness in evaluating the radiographs of welds suggested by the Henry Vogt Machine Company, Louisville, Ky., Prof. C. A. Adams, chairman of the Special Committee on X-ray Requirements, stated (Nov. 24, 1933) that it was the plan of the Committee to have standard films covering the full range of the thicknesses to eliminate all questions of doubt as to the influence of plate thickness on the resulting radiograph.

Other changes were made in Pars. P-102(*i*) and U-68(*i*) on March 24, 1934, for the 1935 edition of all codes, making minor changes in the 1933 paragraphs and providing that the penetrameters be placed so that the thin edge of the gage was adjacent to the end of the exposed portion of the weld, that the film should indicate the job number, the drum, and the seam as well as the manufacturer's identification symbol or name, and that the full set of radiographs for each job be kept on file by the manufacturer for at least 10 years.

The 1935 edition of the Code provided that until more powerful x-ray apparatus was available welds of greater thickness than $4^1/_4$ in. should be completed to $4^1/_4$ in., stress-relieved, and x-rayed, and after completion to full thickness, they should be stress-relieved.

On Sept. 13, 1935, the Special Committee on X-Ray Requirements reported the successful use of a 400-kw x-ray tube with the Buckey grid for examination of welds for heavy plates. The use of this was approved.

The sets of radiographs showing acceptable and unacceptable welds issued by the Boiler Code Committee led to the rejection of welds by inspectors who had the opinion that these were not sufficiently stringent. Some users of petroleum equipment under the API-ASME Code expressed a similar opinion. Because of such action the Boiler Code Committee requested its Special Committee on X-ray Requirements to co-operate in holding a joint meeting with the Joint API-ASME Committee on Unfired Pressure Vessels and the Class One Welding Association for the purpose of correcting these insufficiencies.

HAMMER TEST

On May 24, 1935, a communication from A. J. Ely reported the experience of the Standard Oil Development Company in making the hammer test as required by Par. U-68. As a result of this test there were indications of stress lines radiating from the point of application of the hammer for distances of 2 or 3 in. as well as indentations. He expressed the opinion that where welds had been x-rayed it did not appear necessary to subject the vessel also to the hammer test. The Subcommittee

on Welding and the AWS Conference Committee reported on June 28, 1935, that there was a difference of opinion among members of each committee. Some favored the omission of the hammer test if the joint were x-rayed, but others opposed the omission, bringing out the point that if a vessel was indented and showed stress lines, the hammering had been too heavy and was not suitable. It was reported that the API-ASME Committee suggested the requirement of a hammer with a face softer than the steel on which it was to be used. T. McLean Jasper pointed out a case of his experience in which, had a hammer test been omitted, a defective vessel would have been put into service. He stated that laminations would not be revealed by x-ray as well as by the hammer test. The shape of the hammer also should be considered.

On Oct. 24, 1935, the approval of the retention of the hammer test was reported by the Class One Welding Association and the Subcommittee on Welding. Although the AWS Conference Committee approved the retention, the Board of Directors of the American Welding Society disapproved it and the matter of elimination of the hammer test for U-68 vessels, even with a "flatter" was referred to the Conference Committee.

STRESS RELIEF

The Committee considered (April 23, 1932) the request from the Struthers Wells Company to reduce the temperature of stress relief to 900 F but with a holding time of $1^1/_2$ hour per inch of thickness for a large tank of thin metal to avoid deformation. This lower temperature was not approved as it was the belief that 1100 F to 1200 F had been established as the temperature at which the plasticity of the steel permitted the locked-up stresses to ease and deform the material without separation of any appreciable parts.

On Sept. 14, 1933, the subject of stress relieving was referred to a Special Committee, E. R. Fish, chairman, C. A. Adams, H. C. Boardman, R. E. Kinkead, George Lasker, C. W. Obert, A. C. Weigel, and H. LeRoy Whitney, which had been appointed to consider certain revision of Section VIII of the Code. This Special Committee had met on March 1, 1935, to consider a petition of the Steel Plate Fabrication Association. (Earlier requests were reported in the minutes of Feb. 16, 1934, and April 27, 1934.) As the Special Committee had not time to consider the petition, F. G. Sherbondy, chairman of the Association's Welding Committee, at the suggestion of E. R. Fish addressed the Boiler Code Committee. In presenting proposed small changes in Pars. U-23, U-59, and U-69 and a principal modification to Par. U-76 on stress relieving, he also cited test data supporting the suggested revisions. These data covered results from vessels in service over periods from four to six years with wall thicknesses up to $2^3/_4$ in. for vessels 30 in. in diameter. In all, 100 vessels were included. The recommendations were considered at the morning and afternoon sessions of March 16, 1935, without agreement and again at an adjourned meeting on March 22, 1935. At these meetings the evidence furnished was considered not sufficient to justify the changes proposed for Par. U-69 at that time and the other changes had been disapproved by the Special Committee on Revision of Section VIII. At the meeting of April 19, 1935, Mr. Sherbondy was informed that the Special Committee had not been able to reach agreement on the proposed changes and that for the present the requirements of the Code would remain unchanged. A letter of May 10, 1935, was sent to F. G. Sherbondy by D. S. Jacobus, chairman of the Executive Committee, referring to the reasons for rejection of the proposals as given in a letter of April 11, 1935. This letter also described some of the further data required by the Boiler Code Committee to justify changes in these Sections on stress relief. These letters of April 11 and May 10 were acknowledged on May 23, 1935. Appreciation was expressed of the position of the Boiler Code Committee with respect to safety features of the Code and the requirements of proven experience. Reference was made to proposed tests for further data and also to the Code requirements for nonstress-relieved vessels.

CORROSION RESISTANCE

The subject of the corrosion resistance of welded joints was considered during this period. In December, 1931, the Boiler Code Committee had decided to hold this subject in abeyance, as it was reported that the American Petroleum Institute, (API) was investigating it and that the AWS Conference Committee had suggested a program calling for the collection of data from various sources on observations of tanks welded by specific processes and then placed in service. On Jan. 15, 1932, it was voted to request AWS to continue its investigation and to communicate with the Corrosion Committee of API.

On April 21, 1933, D. S. Jacobus reported that the secretary of the Corrosion Committee of API had stated that it could not co-operate with the AWS because of lack of funds but that it had carried out considerable work on the subject. On May 26, 1933, C. W. Obert reported that on a full investigation he had found that very little had been accomplished in the study of corrosion resistance of welded joints and that there was no report of the work of the AWS although some investigations were being made by Prof. W. O. Harvey of Lehigh University. The Union Carbide and Carbon Research Laboratory were carrying out an extensive series of tests on corrosion of welded joints from which results would be available in a year or more. As a result of this report the subject was again held in abeyance for future consideration.

WELDING OPERATORS

In accordance with Boiler Code Committee action of Oct. 24, 1934, the 1935 editions of the Codes used the designation "welding operators" to replace that of "welders" in the earlier editions.

The qualifications of welding operators had been given in the Codes following those of 1931 and the training of such operators was the responsibility of industry. A letter from Prof. H. W. Hayward of the Massachusetts Institute of Technology was reported on June 22, 1932, enclosing a copy of a letter from the International Brotherhood of Boiler Makers suggesting that universities and technical schools receive samples of the work of welding operators in person or by mail for the purpose of having work approved and certified by such institutions. Professor Hayward outlined the conditions under which the Institute might carry out the suggestion and requested the opinion of the Boiler Code Committee.

The Committee replied (Appendix June 22, 1932) quoting from the Code the responsibility of the manufacturer and his conduct of the tests of welding operators and pointing out that there was nothing in the Code providing for certification of operators by other agencies. The certification outlined for the purpose of determining the suitability of members of the Brotherhood for welding operators would be open to no objection but it could not be recognized by a manufacturer as a replacement for the tests and certification required by the Code and conducted at the shop where the welding was done.

Dean C. P. Bliss of New York University wrote to the Boiler Code Committee that the University had become interested in researches on welding as well as the qualification of welders and that he had corresponded with the U. S. Bureau of Standards. The Bureau intimated that the University would be in a position to organize some plan for the certification of welding operators. This however, the Committee, pointed out, would not free a shop of its tests for qualification.

Struthers Wells Company presented an objection (Sept. 16, 1932) to the requirement of qualification tests at six-month intervals for all welding operators on account of the expense of $40 to $60 even when these men were continuously regularly employed on vessels built in accordance with Code requirements. The Committee replied that the requirement for retests had been adopted with the knowledge that it might require revision and that the subject would be considered later. The Committee then provided in Par. U-69 of 1935 that "when the welding operator is regularly employed on production work embracing the same process and type of welding. . . . . .the tests may be effective for a period of one year."

In May, 1932, a letter was received by the American Welding Society from Turner C. Smith of the General Petroleum Corporation of California regarding modifications of the ASME Code requirements in the tests for welding operators to be used in the California Tentative Unfired Vessel Code. This was considered by the AWS and the Boiler Code Committee and the basis of the rules in the Boiler Code were given which precluded the acceptance of the modification. These were set forth in a letter of Dec. 5, 1932.

BASE METAL AND FILLER METAL

The specifications for the base metal for forge and fusion welding were originally given in the body of the Sections IV and VIII, but after all specifications had been placed in Section II, one of these was transferred to that Section of the Code in the 1935 edition as Specification S-2, Steel Plates of Flange and Fire Box Qualities for Forge Welding. This steel and those of S-1, Steel Boiler Plate, and S-25, Open-Hearth Iron Plate of Flange Quality were permitted also as base metals in the fusion-welded portion of Part 1, Steel Plate Boilers, of the Heating-Boiler Section of the Code. In Section VIII, Specifications S-4, Seamless Steel Drum Forgings; S-26, High Tensile Strength Carbon Steel Plates for Pressure Vessels (2 in. and under in thickness); S-27 (for over 2 to 4 in. in thickness); S-18, Welded and Seamless Steel Pipe; and S-17, Lap-Welded and Seamless Steel and Lap-Welded Iron Boiler Tubes, were added to the earlier three as acceptable with the carbon content limited to 0.35 per cent.

The filling or weld metal of the weld rods, filling rods, electrodes, or other metal used to join two sections of base metal, was described in Section IV in general terms as to its smoothness, cleanness, smooth-flowing quality, and its suitability to produce good welds. No requirements for weld metal were given in the 1935 edition of Section VIII.

A probable reason for this omission was the fact that the Boiler Code Committee by its action on March 15, 1935, believed that adequate requirements for the finished product were sufficient. At that time they were considering an invitation of the AWS Committee on Filler Metal to appoint delegates to a meeting on April 24, 1935, to approve or to suggest a specification for welding rods. It may be noted that the earlier editions of Section VIII of 1925, 1927, and 1930 provided in Par. U-67 that welding wire might be bare, coated, or covered. Moreover Par. U-111 for enameled vessels in Section VIII stated from 1925 until the discontinuance of this part of the Section in 1940 that "any brand of welding wire which has been found by practice to give good results may be used and may be bare, coated, or covered." Section IV, Low Pressure Heating Boilers, from the edition of 1923, required metallic electrodes either bare, coated, or covered for fusion welds in the part of that Section entitled Welded Boilers.

It will be recalled that in chapter 5, E. E. Shanor discussed a method of arc welding in which covered electrodes of the Petroleum Iron Works of Sharon, Pa., were used. In addition the repeated stress test of the B & W Company at Barberton, Ohio, in 1929, described in chapter 6, showed the superiority of arc welds from coated electrodes. It appears that industry became aware of this superiority about 1930.

The Lincoln Electric Company, Cleveland, Ohio, developed a shielded carbon electrode for arc welding which was brought to the attention of the Boiler Code Committee at its meeting on April 27, 1934. The company desired acceptance of this method for all classes of unfired pressure vessels and the advantages of this method of welding were described in a communication. The Committee advised the company that any process of welding might be used that came within the limits of the term "fusion welding," of Par. U-67, and could be demonstrated to the satisfaction of authorized inspectors that it would produce welds which would meet the test requirements of Pars. U-68, U-69, and U-70 according to the class of vessel produced. The manufacturer was responsible for the quality of the welds produced by his operators.

On March 15, 1935, a communication from R. E. Hess, assistant secretary of ASTM, was presented to the Executive Committee. It advised the Boiler Code Committee that Committee A-1 of ASTM had been studying the subject of specifications for iron and steel welding rods, wire, electrodes, and similar filler metals for fusion welding. As the increasing use of welding required unnecessary variations of such material, Mr. Hess suggested that a joint discussion of this subject be held by various interested organizations. The Executive Committee saw no need for such a conference and stated that a similar request had been sent by the American Welding Society and that its Filler Metal Committee would hold a meeting on April 26, 1935, to discuss this problem. The Boiler Code Committee approved the opinion of the Executive Committee and added the statement that such a problem can be best handled by adequate specifications for the finished product.

James Partington and E. R. Fish were appointed to attend the meeting of April 24, 1935, called by C. A. McCune, chairman of the Filler Metal Committee of the AWS.

FLAME CUTTING

In the discussion on March 23, 1934, of the preparation of plate edges for the welding of Class 1 welded pressure vessels, it was brought out that if gas-cut welding edges were reasonably smooth and free from irregularities, welding thereon should be acceptable without planing, milling, or chipping although no definite action was taken at that time.

REQUIREMENTS FOR FUSION WELDING FOR REPAIRS TO INSURED BOILERS AND OTHER PRESSURE VESSELS

The National Bureau of Casualty and Surety Underwriters had been working for some time on the question of uniformity in welding repairs on boilers. In June, 1932, they presented their tentative revised set of rules, based on the 1931 edition of the Unfired Pressure Vessel Code to the Executive Committee of the National Board of Boiler and Pressure Vessel Inspectors for discussion in an attempt to reach an agreement on what would constitute a reasonable set of rules. The purpose was to get the approval of the Executive Committee before sending the rules to the full Board for approval so that something in the direction of uniformity of action would obtain in the field of repair welding. At the meeting of the Board in Columbus in June the proposed revised rules were discussed and the Board requested the Boiler Code Committee to give consideration to the amplified set of rules.

This set of rules was presented at the Boiler Code Committee meeting of Sept. 16, 1932, and referred to the Executive Committee and the Subcommittee on Welding as a joint committee, with the request that the members of the Boiler Code Committee submit their comments to the joint committee. The require-

ment contained 13 numbered paragraphs dealing with stay-bolted surfaces, edges of plates, cracks, fractures, calking edges, stayed sheets, tubes, corrosion, pipe lines, door openings, and unreinforced openings.

At the meeting of Oct. 25, 1932, the discussion of the requirements led to the suggestion that they refer only to repair work, that no welding repairs be made before the repair was sanctioned by the inspector, that fusion welding be allowed when the load was carried by other constructions which conformed to the Code, and that all repairs be carried out under the direction of an authorized inspector. Following this discussion omissions and changes were made in nine of the paragraphs.

The final form of the requirements was reported on Dec. 9, 1932, and referred to the Executive Committee with power. The Committee reported on Jan. 13, 1933, that the few changes were acceptable but that on submission to the National Board of Boiler and Pressure Vessel Inspectors, W. H. Furman, chief boiler inspector of the State of New York, found that they did not correspond to the requirements of the State of New York. For this reason they were referred back to the National Board. The Board reported on an amended form to meet objection and on March 26, 1933, the Boiler Code Committee voted that the requirements as presented to the Committee were consistent with the Code requirements and should give safe results. These requirements consisted of nine numbered paragraphs.

After two years of use these requirements were revised on April 18, 1935, to bring them into agreement with later editions of Code and to include additional parts suggested by their use.

RESPONSIBILITY FOR WELDING VESSELS IN TWO DIFFERENT SHOPS

A communication from the Maryland Casualty Company, Baltimore, Md., reported on May 25, 1933, stated that some boiler manufacturers who had no complete equipment desired to furnish highest-class welded structures and to secure such structures from shops which could produce such drums for their boilers. The question of which shop should apply the stamp was in doubt and directions were asked. This question was referred to a Special Committee consisting of C. O. Myers, chairman, H. E. Aldrich, W. H. Furman and J. P. Morrison. The Committee reported on June 23, 1933, that any part should be stamped by the fabricator of that part and that manufacturer and the inspector making the final inspection were to be held responsible for its meeting Code requirements. The manufacturer of the finished product containing such parts and the inspector of it should obtain a fabrication report from the builders of any parts of the vessel designating such parts and stating that they met code requirements. The fabrication report should bear the signature of a representative of the builder and inspector and should be retained in the files of the manufacturer of the final product. This was adopted and added to Pars. P-332 and U-65. On Sept. 14, 1933, a new wording was suggested for Pars. U-65 and for U-66, and again on March 23, 1934, further changes were found necessary.

The final form of Par. P-332 was adopted on Sept. 14, 1934 from a suggestion of the National Bureau of Casualty and Surety Underwriters through J. P. H. de Windt. It was approved by the National Board of Boiler and Pressure Vessel Inspectors. This provided a new report form called the Manufacturers' Partial Data Report. In principle this Par. P-332 was similar to that proposed by the Special Committee in 1933.

MISCELLANEOUS WELDING ON BOILERS

On Feb. 18, 1932, the Boiler Code Committee considered a communication from Henry Vogt Machine Company, Louisville, Ky., regarding proof tests of two fusion-welded water-tube-boiler headers which had been considered in December, 1931, and referred to the Subcommittee on Welding, the Conference Committee of the AWS, and the Executive Committee. The test data were submitted and the request was made for an expression of opinion as to whether the headers so constructed would be considered as meeting code requirements. Few comments had been received from members of the three committees. One expressed the opinion that the rules pertained to drums and shells only and this new application was one which had not been covered. The question arose as to whether the Committee was ready to express an opinion on headers embodying this class of welding. The AWS Conference Committee reported that the tests indicate that in so far as the hydrostatic tests were concerned the corner welds were as satisfactory as those with a single weld between flanged edges of plates. It therefore believed that if all the Code requirements of design were met, corner welds could be used with safe results and recommended that as the principal stress was shearing the allowable stress be taken as 65 per cent of S or Par. U-20.

The Boiler Code Committee expressed considerable doubt concerning the expediency of Committee action at that time and Mr. Obert suggested that the question be referred to the Subcommittee on Welding and the AWS Conference Committee for study for six months to a year. This assignment should also include the study of the welded stay bolt used in this construction. At the meeting of April 22, 1932, it was decided to submit all future special requests for new uses of welded joints, other than those in Pars. P-101 to P-111 and those relating to compression, to these committees for study.

The definition of corner weld was discussed at many meetings of the Boiler Code Committee. The subject of the attachment of supporting lugs by welding was brought before the Committee on Oct. 19, 1934, and referred to the Subcommittee on Special Design which reported an additional Par. P-325(e) which provided for the design of the attachment of lugs, hangers, or brackets to the shell by fusion welding.

JOINT API-ASME CODE

Copies of the proof of the proposed API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases were sent to the Boiler Code Committee, the Subcommittees on Welding and on Unfired Pressure Vessels, and the AWS Conference Committee in August, 1933, and by the time of the meeting of Sept. 14, 1933, several letters of comments had been received by the secretary. The manner in which these comments should be used was considered by the Executive Committee and it was decided that they should be handed to the chairman of the Joint API-ASME Committee for consideration at the meeting of the joint committee on Sept. 15, 1933, as such action was most desirable. This joint committee consisted of Walter Samans, chairman, R. P. Anderson, secretary, from the API, A. J. Ely, K. V. King (P. D. McElfish, alternate), R. C. Powell, and T. D. Tifft, and from the ASME, R. E. Cecil, E. R. Fish, D. S. Jacobus, T. McLean Jasper, and James Partington.

On Jan. 5, 1934, the tenth draft of the API-ASME Code was presented to the Boiler Code Committee containing the accepted changes to the earlier proofs. Dr. D. S. Jacobus stated that the Boiler Code Committee was asked to review this printing not with the thought of the suitability of it for inclusion in Section VIII, Unfired Pressure Vessels, but for the opinion of the members of its suitability for publication as a Joint Committee Report for public use. Later these rules might be considered in connection with the Unfired Pressure Vessel Code. The consideration of the effect of two sets of rules led to the statement by some members of the Conference Committee of State and Municipal Boiler Inspectors that they were not in favor of two codes to cover the construction of unfired pressure vessels. The study of the new rules might eventually result in

incorporating them in Section VIII or their issue as a separate part of that Section.

The discussion resulted in the appointment of a Special Committee of H. B. Oatley, chairman, I. E. Moultrop, C. O. Myers, and H. Le Roy Whitney to prepare suitable recommendations for the Boiler Code Committee to transmit to the Secretary of ASME as to the manner in which these rules should be handled. This committee reported that it was advisable for the ASME Council to approve the publication of the proposed rules for criticism and comment.

At the meeting of the Boiler Code Committee of Feb. 16, 1934, Dr. D. S. Jacobus, as chairman of the Executive Committee, outlined a letter of Feb. 7 to Walter Samans, chairman of the Joint API-ASME Committee containing the suggestions from the members of the Boiler Code Committee on the Joint Committee Report. This letter mentioned 39 changes and gave reasons for them. It called attention to the low factor of safety, the less stringent requirements for stress relief, and the low standards of inspection. Dr. Jacobus also reported that Messrs. Cecil, Fish, and Partington were the members of the Boiler Code Committee with him at the meeting of the Joint Committee on Feb. 15, 1934, at which time the letter was considered. As the last proof had been accepted by the API, only changes which did not alter the intent of a statement could be made and it was felt that the best plan would be to issue the report as made.

Some of the suggestions of the letter of Feb. 7, 1934, had been followed, but not all. An additional element had been incorporated by following the suggestion that test specimens be stress-relieved in the same manner as the vessel would be relieved and the steel plate stamped accordingly. No attention had been given to the value of the factor to be added to the plate for corrosion or depreciation or on the change in working pressure for vessels at temperatures not to exceed 200 F before throwing out of service. These rules represented a cross section of the views of the API and the ASME, each conceding certain features that agreement might be reached after most painstaking and friendly deliberation.

It was decided that the Boiler Code Committee should take no formal action on the new set of rules at that time.

The API-ASME Code published in September, 1934, contained 133 pages of text with an additional 13 pages of index. Section W, Design and Construction of Fusion-Welded Vessels, covered 62 pages; Section R, Design and Construction of Riveted Vessels, 41 pages; Section I, Inspection Repair and Allowable Working Pressure for Vessels in Service, 17 pages; Section S, Materials and Other Specifications, one page; and an Appendix of five pages. Section S gave merely the list of acceptable ASTM, API and ASA specifications by number.

The exemption (*d*) of the preambles of Section VIII, "vessels for inflammable liquids or gases at temperatures over 300 F," was brought before the Boiler Code Committee from the Joint API-ASME Committee. This committee suggested that the exemption be expanded by including vessels covered by and subject to the inspection requirements of the Joint API-ASME Code. The reason for this suggestion was explained by Mr. Ely of the Standard Oil Development Corporation, and others pointed out the fact that such exemptions in separate codes were satisfactory. A Special Committee was appointed to draw up a suitable wording for this exemption.

At the meeting of Feb. 8, 1935, of the Boiler Code Committee, the members of the Special Committee reported that it advised postponing the change of the exemption pending possible coordination of the two codes into a single code.

SPECIAL COMMITTEE TO REVISE SECTION VIII

A Special Committee to Revise Section VIII to embody the best features of the ASME and the API-ASME Codes and to use API-ASME for all vessels other than those covered by Par. U-70 was approved. This Committee consisted of E. R. Fish, chairman, R. E. Cecil, A. J. Ely, D. S. Jacobus, K. V. King, C. O. Myers, Walter Samans, and H. Le Roy Whitney. The need for revision was brought to the attention of the Committee at its meeting of May 24, 1935, when A. C. Weigel referred to the fact that since the adoption of the Joint API-ASME Code there had been a great amount of unfair competition in the trade. Many industries other than the petroleum industry, realizing that the cost of vessels was less when built under the new code than under Section VIII, had been ordering under that code. The new code required inspection by a qualified inspector but did not establish qualifications. It did not fix the authorization for affixing the stamp nor that the affixer had determined that all tests and requirements of the Code had been met. He advised that 90 per cent of the unfired pressure vessels for which his company had inquiries or had quoted had been based on the API-ASME Code. This information was to be sent to the Joint API-ASME Committee and to the Special Committee to Revise Section VIII.

TENSILE STRENGTH OF RIVETS

The tensile strength of rivets used in the connection of domes was brought before the Boiler Code Committee by T. C. Smith of the General Petroleum Corporation on April 22, 1932, and referred to V. M. Frost and then to A. C. Weigel. Mr. Weigel reported that from data of the publications of the University of Illinois and the American Institute of Steel Construction it appeared reasonable that 8000 psi in direct tension might be used with safety until further test data were available. This suggested the appointment of a special committee to formulate a revision of Par. P-193(*a*) consisting of H. E. Aldrich and A. E. R. de Jonge.

Mr. Aldrich reported on Feb. 16, 1933, that after considerable work the special committee had prepared the report given in the Appendix to the minutes. This showed that 8000 psi for rivets which held nozzles was safe and also that the permissible stress in the rivets for crow-foot braces (Table P-8 with Pars. P-222 and P-223) was safe within reasonable limits of usage. For rivets in domes the permissible stress with a factor of safety of 5 was not over 7200 psi because of the many factors which had to be considered. At the suggestion of Mr. Aldrich the report was referred to the Subcommittee on Boilers of Locomotives and the Special Committee on Reinforcement of Openings.

The report of 13 pages was made by A. E. R. de Jonge to H. E. Aldrich based on the experiments of Prof. C. R. Young in Canada on the ultimate strength of rivets stressed in pure tension, and combinations of tension and bending, tension and shear, and with tension, shear, and bending. From these Mr. de Jonge derived curves which could be used for any condition of combined tension and bending and combined tension, shear, and bending. He then gave the result of his work as well as the analysis used, including a bibliography of 16 references extending from 1899 to 1930.

James Partington, chairman of the Subcommittee on Boilers of Locomotives, reported on March 24, 1933, that his committee approved the recommendation of 7200 psi for rivets in dome rings, and D. B. Wesstrom, chairman of the Special Committee on Reinforcement of Openings, also approved this limit.

The latter committee recommended an addition to Par. U-59 (*b*) on riveted connections to provide for this stress. At the next meeting of the Committee this change (7200 psi) was made in Par. U-33 on domes, nozzles, and manholes over 16 in. in diameter, with 12,000 psi for the latter two if 16 in. and under.

In reply to a communication of Sept. 14, 1933, which objected to the limit of 7200 psi, the Subcommittee on Special Design

reported at the October meeting that this allowable stress was intended to apply to cases in which the rivets carried all the load from the dome and if stays were used safety could be determined best by a hydrostatic test and that the limit of 7200 psi should be applied to the rivets of manhole frames in which the saddle flange thickness was $^{7}/_{8}$ in. or less.

VESSELS SUBJECTED TO EXTERNAL PRESSURE

W. D. Halsey, chairman of the ASME Special Research Committee on the Strength of Vessels Under External Pressure, reported on the proposed rules which had resulted from their research which had been requested by the Boiler Code Committee. This committee first reviewed all of the existing formulas, about 15, which had been proposed for vessels subjected to external pressure. Some were based on the experiments of Stewart, Fairbairn, or Cammer pertaining to long vessels of relatively small diameter. Very little data were available for short vessels with the effect of the support from the heads of the vessel. Others, such as those for the Adamson formula for furnace rings, were based on limited experiments and were practically empirical.

Experimental work for the report had been conducted by Prof. T. McLean Jasper and Mr. Sullivan at the plant of the A. O. Smith Corporation and by Commander H. E. Saunders and D. F. Windenberg of the Model Basin at the Washington Navy Yard. The results of the methods of investigations of these two groups were the same but the one developed by the Navy Department was simpler to apply.

The formulas to determine the strength were in many cases too complex to be included in a Code for the use of the average tank or boiler fabricator so the Research Committee attempted to simplify the application by the preparation of rules with charts which could be easier to understand and apply. The results had been carefully checked with the tank failures on which data were available. The forms tested were those for which inquiries had been made and the results were applicable to steel for pressures less than 500 psi and for temperatures not in excess of 700 F. The working pressure was fixed at one fifth of the collapsing pressure. Some of the members of the Special Research Committee felt that a lower factor of safety could and should have been used.

The Rules reported by the Committee were dated December, 1933, and covered 12 pages. They were accepted for publication in MECHANICAL ENGINEERING and became Pars. U-120 to U-138 of Section VIII of the Code.

OBJECTION TO FREQUENT REVISIONS

The issuance of frequent revisions was brought before the Committee of Dec. 9, 1932. Frequent revisions were objected to by state boiler-inspection departments because of the effect on their printed rules which thus became antiquated and from builders who had to change designs. C. W. Obert also pointed out that many of the interpretations which became Code rules could have been handled by the National Board of Boiler and Pressure Vessel Inspectors and thus made for certain relief. The discussion of this subject led to appointment of a Special Committee to advise the Boiler Code Committee on the ways, means, and scope of its work.

PROTEST OF OHIO BOARD

On Feb. 8, 1935, a protest of the Ohio Board of Boiler Rules against the number of revisions and interpretations of the Code was announced to the Boiler Code Committee. It pointed out that whereas they appreciated the developments and advancement of the art, especially as it pertained to welding of seams and to new materials, it was their opinion that it should not be the policy of the Committee to consider through interpretation or revisions, questions of construction for special designs that were not covered by the Code. It recommended that fabricators of vessels should be given to understand that their product must be constructed in accordance with the Code instead of revising the Code to suit any particular construction. It pointed out the importance of uniformity of boiler regulations throughout the states and municipalities with a minimum of interpretations and revisions.

SCOPE OF WORK OF BOILER CODE COMMITTEE

The Special Committee to Study Ways, Means, and Scope of the Work of the Boiler Code Committee, H. E. Aldrich, chairman, E. R. Fish, V. M. Frost, C. O. Myers, H. B. Oatley, C. W. Obert and A. C. Weigel were appointed Jan. 13, 1933, and reported on Sept. 14, 1933. The report called attention to the complaints on the volume of Addenda matter and interpretations accompanying the issuance in 1931 of the new welding rules, the largest ever issued at one time. The need for such a large number was not contemplated. Many of the complaints were justified and the volume of addenda and interpretations should be curtailed. The committee recommended that these be continued as the needs of the industry dictated but that a special effort should be made to restrict the number to a minimum to meet actual needs.

The committee pointed out that the method of conducting a meeting should be changed and extraneous matter overruled and the conduct made more formal. The report contained an order of procedure regarding inquiries, communications, interpretations, committee reports, revisions, hearings, power boiler, program, and meeting.

In addition form letters were given dealing with the greatest amount of Committee correspondence. The purpose of this report was (1) to expedite and simplify the work of the committee, (2) to shorten the length of the meeting, (3) to give opportunity for consideration of inquiries by proper subcommittees, (4) to spread the burden of the work over a greater number of members of the Committee, and (5) to give the secretary a definite method in so far as possible for handling correspondence and preparing the program.

U. S. NAVY SPECIFICATIONS FOR MACHINERY

The Bureau of Engineering, U. S. Navy, submitted a copy of tentative changes and additions to its General Specifications for Machinery used as the basis of construction and for purchase of propulsion machinery asking for comments or criticism. This was announced at the meeting of Jan. 13, 1933, and the changes and additions covering 10 pages were referred to the Subcommittee on Welding and the AWS Conference Committee.

Criticism was reported on March 24, 1933, of such a nature that a conference with representatives of the Bureau of Engineering and a small group of the Boiler Code Committee and the American Welding Society was recommended.

The Conference took place at the Engineering Experiment Station at Annapolis, Md., on April 11, 1933, and at Washington, D. C., on April 12, 1933, with Capt. H. R. Greelee of the Experiment Station and Commanders C. A. Jones and C. S. Gillette, of the Bureau of Engineering, U. S. Navy. H. S. Jeans of the New York Navy Yard was delegated to report to the Bureau. The American Welding Society was represented by C. A. Adams, J. J. Crowe, and C. W. Obert, and the Boiler Code Committee by E. R. Fish, D. S. Jacobus, H. B. Oatley, James Partington, and R. K. Hopkins for H. LeRoy Whitney.

A paper was presented at Annapolis by Bela Ronay on a new instrument, the Arcronograph, which analyzed electric-arc welding by recording voltage across the arc during welding on a

chart and revealed the nature of the welding by drops of metal. It recorded the history of each drop and determined electrode performance. This paper was followed by a discussion of features of arc welding and a magnetic device was shown for examining the uniformity of rods. Demonstrations were made to show this. Pieces were welded and defects which were indicated by the Arcronograph were found on breaking one of the weld specimens. The Engineering Experiment Station was visited in the afternoon.

At the meeting at Washington on the next day in the Board Room of the Bureau of Engineering, Commander Jones explained that the Bureau was not set on electric-arc welding as seemed to be understood from their specifications but the gas-welding industry had not given the data from which to write such specifications.

The remainder of the session in Washington was under the chairmanship of Commander Gillette and the subject of fusion welding was discussed by him and then in detail by Messrs. Adams, Fish, Jacobus, and Partington. Mr. Oatley had presented to Commander Gillette a copy of the suggestions and criticisms made by Mr. Partington and his committee on March 21, 1933, and then these were discussed.

RULES FOR BOLTED FLANGED CONNECTIONS AND FOR FLATHEADS AND COVERS

The tentative report of the Subcommittee on Special Design, D. B. Wesstrom, chairman, giving the Rules for Bolted Flanged Connections and proposed revisions of the rules in the Code for flatheads and covers, was formulated by a Special Joint Committee with representatives from the ASA Sectional Committee on Pipe Flanges and Fittings, the API, and the Subcommittee on Special Design. This was presented on Feb. 16, 1934. F. S. G. Williams, acting chairman of the Special Committee, explained the principal features of the report and the difficulties of the problems encountered. The letter of transmittal was accompanied by five pages of text and tables and one sheet with two figures on Proposed Rules for Bolted Flanged Connections and three pages of text and one page of forms of heads on Proposed Revisions of Rules for Flat Heads and Covers.

The first finally became Pars. UA-16 to UA-22 and the latter was applied in Pars. P-198 and U-39.

ACTIVE AND INACTIVE INTERPRETATION

E. R. Fish reported that he had revised and brought up to date the résumé of interpretations in the same manner as that used when V. M. Frost and he had previously compiled a list and he suggested that the list as of June 29, 1933, be issued. The active interpretations were examined again in 1935 by V. M. Frost to suggest the necessary addenda for the 1935 edition of all of the sections of the Code.

MERCURY BOILERS

The Executive Committee reported on Jan. 15, 1932, that it had studied the details of design for the Mercury boilers to be installed at the General Electric plant at Schenectady, N. Y., and at the Kearney (N. J.) Plant of the Public Service Electric and Gas Company, Newark, N. J. Additional data had been received from the General Electric Company regarding these installations and those in use for years at the Hartford Electric Light Company, Hartford, Conn. The features were fully discussed and it was voted to recommend to the chief boiler inspectors of the states of New Jersey and New York acceptance of the installations of the units in each state as a special case.

FOREIGN-MADE BOILERS

A communication from R. E. W. Harrison, chief, Machinery and Agricultural Implements Division of the Department of Commerce, was received by the Executive Committee before the meeting of Jan. 4, 1935, transmitting a copy of a letter from H. E. Stebbins, Assistant Trade Commissioner of the U. S. Embassy in London, England. This letter made inquiry relative to the inspection under ASME Code requirements of British-made boilers for export to the United States. The Sentinel Wagon Works of Shrewsbury, England, had received an order from the United States for a steam wagon. The Executive Committee had asked Mr. de Windt for an opinion and he stated that at the meeting of the Executive Committee of the National Board of Boiler and Pressure Vessel Inspectors it was the opinion that an inspector in England could be qualified by passing an examination by a Board of two or more members of the National Board in some state that had adopted the Code. The passing of this examination would entitle him to a National Board Commission which would be acceptable in the United States with the exception of Massachusetts. The manufacturer would have to make application for a stamp and fulfill all requirements of the Code so that the boiler could be stamped. The Committee referred the opinion of the Executive Committee of the National Board to the Executive Committee of the Boiler Code Committee and Mr. Myers was asked to reply.

A letter was sent to the acting secretary, Miss M. Jurist, from C. O. Myers, dated Feb. 7, 1935, pointing out two methods of inspection, one by the passing of an examination by a foreigner, the other by having a qualified inspector of the United States inspect the boiler construction in England. Miss Jurist communicated this to Mr. Stebbins on Feb. 8, 1935, with a copy to Mr. Harrison.

Mr. Harrison suggested that an international trade law might include reciprocal inspection agreements. It was pointed out to him that inspection was a state and not a national matter.

MATERIALS

The Subcommittee on Material Specifications during this period consisted of P. R. Cassidy, chairman, A. M. Greene, Jr. J. O. Leech, and P. J. Smith of ASME; C. L. Warwick, chairman, E. J. Edwards, and C. F. W. Ryst of ASTM, and J. O. Leech, chairman, E. F. Kenney and A. D. Peace of AASM. It arranged for the introduction of the revisions of many of the specifications so that they would agree with the latest form of the earlier ASTM Specifications which had been adopted and proposed the adoption of six additional ASTM specifications S-26 to S-31. S-26 and S-27 were for High-Tensile-Strength Carbon-Steel Plates for Pressure Vessels, the first for plates 2 in. and under in thickness, the latter for plates over 2 in. in thickness. S-28 was for Chrome-Manganese Silicon Alloy Steel Boiler Plate, S-27 for Seamless 70-30 Brass Condenser Tubes and Ferrule Stock, S-30 for Seamless Muntz-Metal Condenser Tubes and Ferrule Stock and S-31 for Seamless Admiralty Condenser Tubes and Ferrule Stock.

On Jan. 15, 1932, this Subcommittee reported that the Code did not require the presence of an inspector in a steel mill but only required the mill report and specified physical and chemical properties. Hence foreign-made sheets and solid drums meeting those requirements could be used in Code structures. On June 23, 1932, the Committee confirmed this ruling for foreign boiler material.

The Committee recommended that boiler tubes made by the Johnson Electric Welding method be acceptable under the specifications S-17 and S-18 for lap-welded tubes and pipes and that no further action be taken at that time regarding electric-resistance-welded pipe as the ASTM Specification for such pipe (A 135-31T) was in a highly tentative form and would require a number of revisions; but the pipe as made should be permitted under lap-welded pipe and tube specification.

At this same meeting of the Committee a special committee of H. Le Roy Whitney, Perry Cassidy, E. R. Fish, and H. B. Oatley was appointed to consider the allowable stress on the fusion-welded pipe which had been reported.

ACCEPTABILITY OF OTHER MATERIALS

ELECTRIC-FURNACE STEEL

The Subcommittee on Materials recommended on Sept. 16, 1932, that electric-furnace steel be considered acceptable under the Code in specifications requiring open-hearth steel. This was cared for by the alteration of ASTM specifications to the "Process" clauses of its steel specification by adding the words "or electric furnace."

EVERDUR

Everdur, a high-strength copper alloy of the American Brass Company, had been presented as a vessel material in 1928, but in February, 1932, the Boiler Code Committee was asked to consider it as a material for a fusion-welded pressure vessel for 300 psi. The physical and chemical properties of the material given in the reply to this case permitting its use indicated the requirements which should be met. On April 27, 1934, this material was permitted for the shell of a low-pressure heating boiler.

CROMANSIL

The Petroleum Iron Works Company, Sharon, Pa., requested an opinion on cromansil as a material for use in fusion-welded pressure vessels which under Par. U-71(*c*) might be considered for new material. The weldability of this was questioned and a special committee, C. A. Adams, chairman, Dr. A. Sauveur, F. H. Farmer, Perry Cassidy, and James Partington, was appointed to form a statement of facts and data which should be known before the Boiler Code Committee could consider its use for a welded vessel. Co-operation with AWS was directed. The report of Feb. 16, 1933, recommended that a specification for the material be requested of the appropriate committee of ASTM or with its co-operation, and that (1) welds should meet present test specifications for plain-carbon boiler steel maintaining the same ductility, (2) a breathing test on full-sized pressure vessels should be made, (3) creep test should be made for proposed range of temperature use, (4) fatigue test should be made of welded sample, (5) a careful study should be made of effect of the heat of welding on adjacent base metal, and (6) the structure of the metal weld should be determined.

On April 21, 1933, it was reported that the Lukens Steel Company were conducting tests at Lehigh University on riveted joints of plates of cromansil alloy steel and on Nov. 24, 1933, the high-strength rivets of that material which had been developed were reported as described in the paper, "High Strength Rivets," in the Oct. 2, 1933, issue of *Steel*. Dr. Adams stated at this meeting that the manufacturers of cromansil had objected to the lengthy breathing test.

On Jan. 5, 1934, Perry Cassidy, chairman of the Subcommittee on Material Specifications, presented a specification for this steel alloy with chromium, manganese, and silicon, which had been developed by the Carbide and Carbon Corporation. This specification had been prepared also by the Subcommittee as directed at the November meeting. The material had not been considered by it as a material for welding. The Subcommittee saw no reason why it should be questioned for unfired pressure vessels or power boilers with riveted joints as it had much greater strength. C. W. Obert pointed out that it had been developed after five or six years of work and has been in actual use for three or four years. It was requested that the suitability of cromansil for riveted construction be submitted by the Carbide and Carbon Corporation to recognized metallurgists. The proposed specifications were submitted to George B. Waterhouse, Massachusetts Institute of Technology, William Campbell, Columbia University, Vsevolod N. Krivobok, Carnegie Institute of Technology, and Herbert M. Boylston, Case School of Applied Science, as reported by C. W. Obert on Feb. 16, 1934.

On April 27, 1934, Mr. Obert reported that the Carbide and Carbon Corporation had decided to weld sample drums and submit them to breathing tests at the Barberton plant of the Babcock and Wilcox Company. On asking if such test would give the information desired by the Special Committee on Alloy Steels for Welded Pressure Vessels, Dr. C. A. Adams pointed out the desire for heat and creep tests and the breathing test was the equivalent of the fatigue test. Perry Cassidy called attention to corrosion fatigue. Mr. Obert was requested to submit the scope of the proposed tests to the Special Committee.

On Dec. 6, 1935, a report was made that the cromansil alloy-steel tank being tested at the Hedges-Walsh-Weidner Company plant at Chattanooga, Tenn. had been subjected to 250,000 alternations from 0 to $1^1/_2$ times the working pressure to prove the satisfactory qualities for the use of this alloy steel. The stress at the high pressure was 25,000 psi with 85,000 psi material. The tank was 34 in. in diameter and about 8 ft long made of $^1/_2$-in. plate. The yield point was 66,000 to 70,000 psi. The intention, as explained by C. W. Obert, was to carry this test to 500,000 alternations and then test to rupture in order to examine the joints and the interior of the vessel. He desired to know if the Committee wished the test to go beyond 500,000 alternations. This request was referred to the Special Committee on High Tensile Steels for Welded Pressure Vessels.

On Nov. 23, 1934, the maximum shearing strength of Grade A, cromansil was made 60,000 psi in single shear and 120,000 psi in double shear with a crushing strength of 120,000 psi.

HIGH-TENSILE-STRENGTH STEELS—FATIGUE TESTS

On Feb. 8, 1935, the tensile strengths of high-tensile-strength carbon-steel plates were fixed at 70,000 psi for S-26, while for S-27, 65,000 psi was fixed for Grade A and 70,000 for Grade B. The strength for cromansil S-28 was fixed at 75,000 psi for Grade A and 85,000 psi for Grade B. For materials of S-26 and S-27 the crushing strength was given as 95,000 psi, the same as firebox steel of S-1.

The permissible use of molybdenum steel for boiler drums and pressure vessels was brought to the Boiler Code Committee on June 29, 1934, by A. C. Weigel, Combustion Engineering Corporation, New York. This steel similar to ASTM A 149-33T and A 150-33T, was proposed for boiler drums or vessels welded in accordance with Par. U-68, (Class 1) with carbon 0.15 to 0.25 per cent and molybdenum 0.040 to 0.060 per cent. This was referred to the Subcommittee on Material Specifications. Perry Cassidy, chairman of that Subcommittee, pointed out that it had no information of the suitability for welding and that proof tests and other data should be furnished.

The Subcommittee on Material Specifications reported on Oct. 19, 1934, that the committee believed that breathing tests were not always necessary to prove the adaptability of a new alloy to breathing tests, it held that check tests on specimens cut from welded joint perpendicular to the weld could be combined with fatigue tests which would not only test the weld metal but the joint between the weld metal and the plate. A number should be made and the results should check within reasonably close limits. The results should be compared with those from standard 55,000-psi fire-box steel plate and possibly with 70,000-psi-tensile-strength plate. Positive proof should be submitted that the physical properties could be obtained from the chemical analysis proposed. Actual tensile tests should be presented from plate of actual thickness, preferably up to 4 in. at least in accordance with those with S-27

metal. The discussion of this subject showed agreement on the elimination of the breathing test at least for low-alloy metals. H. Le Roy Whitney suggested the addition of an impact test.

NONFERROUS METALS

"Herculoy," a copper alloy of the Revere Copper and Brass, Inc., Rome, N. Y. (Cu 95.2 per cent, Si 3.25 per cent, tin 0.5 per cent, and zinc 1.0 per cent) was presented to the Committee as a permissible metal for use in unfired pressure vessels in accordance to the reply given in Case No. 715 permitting the use of Everdur. As it has not the same composition as Everdur it had been presented as a competitive material. E. R. Fish was requested to obtain further data and the suggestion was made that the Subcommittee on Material Specifications ascertain if it were possible to secure a specification covering both of the alloys. As this was not possible at that time, use was made of Case No. 778 and Herculoy was allowed under Par. U-69 with restrictions given in the reply of May 25, 1934.

Monel metal for nipples in blowoff connections was sanctioned on Jan. 16, 1934, by an addition to Par. P-9 allowing materials of "ferrous or nonferrous materials having physical characteristics which are not less than those required for welded or seamless steel pipes and the strength of which is not impaired by the temperature to which they are subjected."

Permission for the use of high-strength copper-nickel alloy or that of the 18–8 chrome-nickel-alloy steel was asked on May 25, 1934, by the Linde Air Products Corporation for a seamless pressure vessel to be used at low temperature with a stress allowance of 11,000 psi and a temperature of —297 F. This was referred to the Executive Committee and H. B. Oatley and conference with the National Board of Boiler and Pressure Vessel Inspectors. On examination of the design with a material of 95 per cent copper, 3 per cent silicon, and 1 per cent manganese, the construction of this low-temperature vessel with proper reinforcement of opening was approved (Case No. 780) on June 29, 1934.

On Sept. 14, 1934, C. W. Obert reported that he had submitted a draft of specifications for Monel metal and 18–8 chrome-nickel-alloy steel to the Subcommittee on Material Specifications for an expression of opinion as to whether they would be suitable for the particular service being considered by the Boiler Code Committee. At the October meeting the Subcommittee explained why these specifications could not be used. The Committee voted to use them in making the necessary qualifying replies to the cases asking for the use of these materials under Par. U-12 which provided for the use of new materials as they were developed and as had been done in many previous cases. The replies to Cases Nos. 792 and 793 were issued pending the results of the joint action of Boiler Code Committee and the American Society for Testing Materials.

S-1 STEEL WITH NICKEL

Steel meeting the specification S-1 but containing $1\frac{1}{2}$ to $2\frac{1}{2}$ per cent of nickel added to the metal to obtain a tensile range of 70,000 to 80,000 psi and yield strength of 0.6 T.S. and an elongation in 8 inches not less than 25 per cent was approved for stamping with Code symbol for small high-pressure heating boilers to be used by Pennsylvania Railroad on diesel locomotives as had been granted in 1930.

S-29 AND S-30 TUBES

Specification S-29 (ASTM B55-33) for Seamless 76-30 Brass Condenser Tubes and Ferrule Stock, and S-30 (ASTM B56-33) for Seamless Muntz-metal condenser tubes and Ferrule Stock were added to Section II, Material Specifications on the request from the Subcommittee on Unfired Pressure Vessels on Feb. 8, 1935.

MALLEABLE IRON

On April 19, 1935, a number of members of the Manufacturers Standardization Society of the Valve and Fittings Industry requested a change in Par. P-12 so as to permit the use of a lower grade of malleable iron than that in S-15. After discussion of the reason for limitation for use, the Committee voted to make no changes.

CAST IRON

At this same meeting E. R. Fish recommended that some provision be made in the Unfired Pressure Vessel Code for the use of cast iron in the construction of such vessels. He presented certain additions to Pars. U-13 and U-59(e). Others urged that the use of such material should not be encouraged. Advantages and disadvantages were mentioned by different members of the Committee. A Special Committee, E. R. Fish, V. M. Frost, and H. B. Oatley, was appointed to consider this matter and report to the Executive Committee for authority to publish in MECHANICAL ENGINEERING.

NICKEL-CLAD-STEEL PLATES

The Committee accepted (Oct. 24, 1935) the progress report of the Subcommittee on Material Specifications that on nickel-clad steel plates the same objections as to difference in coefficients of expansion as occur in plates clad with stainless steel did not hold but the Subcommittee advised that (1) the base metal be a Code metal, (2) that the strength of the welded plate be figured on the thickness of the base metal, (3) that the weldability of nickel-clad plates be referred to the Subcommittee on Welding and the AWS Conference Committee, and (4) the Boiler Code Committee should decide on temperature limit based on the difference of expansion between the cladding and the base metal.

AMERICAN MARINE STANDARD COMMITTEE
SUBCOMMITTEE ON MARINE BOILER RULES

On Feb. 18, 1932, D. S. Jacobus reported that the Committee that had been appointed by Hon. R. P. Lamont, Secretary of Commerce, about two years before to co-ordinate Marine Boiler Rules, had submitted its report to D. N. Hoover, Supervising Inspector General of the Steamboat Inspection Service. The Service had decided to publish suggested rules for the construction of fusion-welded marine boilers and pressure vessels as an appendix. For this purpose a committee of AWS had co-operated and the Board of the Directors of AWS had approved those welding rules at its meeting on Jan. 5, 1932. The Fusion Welding Rules of Sections I and VIII of the ASME Boiler Code had been used as a basis with modifications to fit marine application.

It was reported on April 22, 1932, that there was a proposal to consolidate the Steamboat Inspection Service and the Bureau of Navigation into a new bureau known as the Bureau of Navigation and Steamboat Inspection.

Senate Bill No. S-1129 was reported to the Committee on April 21, 1933. This bill related to the construction and inspection of boilers, unfired pressure vessels, and the appurtenances thereof, which would set up a new Board of Supervising Inspectors and empower it to make rules and regulations covering the design, construction, and inspection of boilers, pressure vessels, and piping.

J. W. Wilson, of the Bureau of Navigation and Steamboat Inspection, who had attended meetings of the Boiler Code Committee for several years as a representative of D. N. Hoover, Supervising Inspector General of that Service, stated that the support of this bill by the Boiler Code Committee would, no doubt, be helpful in the consideration of it by the Senate. The new rules for which this bill provided would be submitted

to the public for comment as soon as the bill was passed. Action regarding the support of this bill by the Boiler Code Committee or by the American Engineering Council was referred to the Executive Committee with power.

The first report of the Committee to Co-ordinate the Marine Boiler Rules was sent to the members of the Boiler Code Committee, and as D. N. Hoover, Assistant Director of the Bureau of Navigation and Steamboat Inspection, had asked for comments on the rules by March 1, 1934 (later made April 1), and the matter of suggestions was considered by the Committee on Feb. 16, 1934. As individual comments by members would mean duplication in some of these comments, D. S. Jacobus suggested that these replies be sent to V. M. Frost, chairman of the Subcommittee on Marine Boiler Rules, which was the successor to the former committee which had worked with the American Marine Standards Committee. The earlier committee had aided in the formation of the rules which had been created by the Committee formed by Secretary Lamont.

In sending in the suggestions of the Boiler Code Committee as combined by V. M. Frost, a set of resolutions was included covering the approval of Rules I and II of the General Rules and Regulations, with congratulations to Hon. H. N. Hoover on the successful results of his efforts in having a bill passed by Congress which freed the Service of old and incomplete rules that had been enacted into law in the past and permitted the use of the rules which he had initiated and were up to date. It also stated that the Committee endorsed certain proposed changes which it submitted for the consideration of the Bureau and it thanked General Hoover and James W. Wilson for their co-operation and help in the work of the Boiler Code Committee.

GENERAL RULES

The amended Rules I and II—General Rules and Regulations were called First Supplement to General Rules and Regulations, January 1, 1935.

These were adopted persuant to the authority conferred by the Act of June 13, 1933, amending Rule I and II pertaining to the design, construction, and inspection of boilers, unfired pressure vessels, and the appurtenances thereof.

The foreword was signed by the members of the Co-ordinating Committee mentioned in the foregoing chapter and contained in pages I to XI, including title and table of contents with 164 pages of text and 19 pages of index.

Rule I on Specifications covered 44 pages and Rule II on Design, Construction, Installation, Inspection, and Repair of Boilers, Pressure Vessels, and Piping Systems covered 120 pages.

The material specifications were mostly marked "in substantial agreement with" some ASTM Specifications.

In Rule II many of the diagrams and formulas were based on those of the ASME Codes. Section 20 on Fusion Welding bore the note "these rules are based on those prepared by a Subcommittee of the Committee on Welding in Marine Construction of the American Welding Society which in turn were based on those prepared by the Boiler Code Committee of The American Society of Mechanical Engineers with the co-operation of the American Welding Society."

CHANGES IN PERSONNEL

The members of the numerous special committees, to whom questions of immediate import were referred and whose terms of service were for short periods are not listed because of the number and their transient nature. These committees were composed of members of the Boiler Code Committee and nonmembers whose experience and interests made them most valuable in solving the problems submitted.

The list of Honorary Members was increased by the names of F. W. Dean and E. F. Miller (Oct. 28, 1932) and also W. F. Durand and M. F. Moore (Oct. 24, 1935). The death of Prof. E. F. Miller on June 12, 1933, removed from the list of Honorary Members the name of one of the original members of the Boiler Code Committee.

R. E. Cecil and A. C. Weigel (April 22, 1932) were added to the Boiler Code Committee as well as Walter Samans and A. J. Ely (Oct. 19, 1934). Prof. C. A. Adams was appointed Nov. 23, 1934, and H. C. Boardman and W. G. Humpton on Dec. 8, 1935. C. L. Warwick resigned from the Committee on Sept. 13, 1935.

The Subcommittee on Material Specifications lost C. L. Warwick by resignation on Dec. 31, 1935 to be succeeded by P. J. Smith.

A. J. Pack retired from the Subcommittee on Boilers of Locomotives on Sept. 13, 1931.

The subcommittee on Heating Boilers lost the services of M. F. Moore and W. A. Nevin by retirement and of R. Stresan and Raymond Newcomb whose deaths were reported Feb. 12, 1932. Those added to the subcommittee were J. W. Lockett (April 23, 1932) and C. E. Bronson (Jan. 4, 1935), and John A. Darts replaced J. W. Lockett who resigned Oct. 19, 1934.

G. A. Luck succeeded J. H. Plunkett on the Subcommittee on Miniature Boilers, Oct. 24, 1934.

The annual report of the Boiler Code Committee made in September, 1933, noted the appointment of William Ferguson to the Subcommittee on Rules for Inspection.

The Subcommittee on Welding lost J. A. Dixon (May 20, 1932) and Henry Torrence (Dec. 8, 1935) by retirement.

The Subcommittee on Special Design was appointed on March 24, 1933, on the discontinuance of the Special Committee on Reinforcements of Openings. It consisted of D. B. Wesstrom, chairman, W. L. Bowler, R. E. Cecil, Paul Diserens, H. E. Rockefeller, D. W. H. Rowand, and F. S. G. Williams. D. B. Rossheim was appointed a member in June 29, 1934, and Prof. E. O. Waters, on Jan. 3, 1935. Paul Diserens retired on May 24, 1935.

The Committee to Confer with the Massachusetts State Board of Boiler Rules of Feb. 19, 1932, consisted of D. S. Jacobus, chairman, F. S. Clark, E. R. Fish, and I. E. Moultrop.

The Boiler Code Committee noted with sorrow and regret the death of Calvin W. Rice, Secretary ASME, on Oct. 2, 1934. A resolution describing his interest, aid, and encouragement was entered in the minutes of the Boiler Code Committee.

In reporting personnel matters it is a pleasure to note that on June 23, 1932, Chairman F. R. Low attended the meeting with Dr. D. S. Jacobus, vice-chairman presiding. Throughout the years of this period Mr. Low was confined to his home or the hospital but his continued interest, was shown by the receipt of frequent telegrams to the Committee or some one of its members.

REPRESENTATIVES OF GOVERNMENT AGENCIES

During this period (Jan. 1932–Sept. 1935) the minutes record the presence of J. W. Wilson as representative of the Steamboat Inspection Service or the Bureau of Navigation and Steamboat Inspection Service.

From April 21, 1933, to December, 1935, the minutes show the attendance of a Commander of the U. S. Navy as the representative of the Bureau of Engineering. This attendance resulted from an invitation by the Boiler Code Committee sent to the Bureau in reply to a letter of Sept. 16, 1932, from Admiral S. M. Robinson, chief of the Bureau of Engineering, asking for copies of the Code and requesting the listing of the Bureau for future publications. As the Committee had co-operated with other departments of the National Government, the request was granted and an invitation was extended for the attendance of a representative of the Bureau.

ADVISORY BOARD OF STANDARDS AND CODES

On Dec. 7, 1934, the ASME Council set up an Advisory Board of Standards and Codes consisting of a chairman from the ASME Council and one member from each of the following committees: Boiler Code, Standardization, Power Test Codes, and Safety. This Board was advisory to the Council and assisted it in establishing (1) general policies pertaining to standards and codes, (2) initiating and developing standards and codes, and (3) co-ordinating the activities of the several committees represented by its membership. V. M. Frost was designated as the representative of the Boiler Code Committee on the Board. Authority had been delegated by the Council to this Board to approve actions of the Boiler Code Committee.

Under this arrangement the actions of the Boiler Code Committee were entered into the minutes of the Council and the Committee still remained a creature of the Council.

CALIFORNIA ACTIVITIES

In January, 1932, the proposed revision of the Air Tank Safety Orders were received from F. A. Page, supervising engineer, Boiler Section, Industrial Accident Commission, State of California.

It was the desire of the California Industrial Commission to adopt the 1931 Code for Unfired Pressure Vessels for its Safety Orders but local conditions and the pressure of local industries made it necessary to follow the suggestions of its Revisions Committee. The revisions proposed by the San Francisco group had been rejected by the Los Angeles group. The Boiler Code Committee was requested to consider the various alternatives. The report was referred to the Executive Committee and R. E. Cecil, H. B. Oatley, and H. Le Roy Whitney.

A letter of six pages of March 28, 1932, commenting on 35 of their numbered paragraphs was sent by the Boiler Code Committee to Mr. Page. His reply of April 15 discussed the reply and indicated the way in which certain paragraphs were then worded. This was referred to the same group of the Boiler Code Committee. The reply to this letter was before the Committee as reviewed by Perry Cassidy on May 22, 1932, and approved for transmission by the Committee.

In a letter of April 16, 1932, F. A. Page presented, in connection with his objections to inserted heads, single welded on the outside only, a report of the failure of one of this type of heads on April 13, 1932. This happened in a garage but there were no injuries and only nominal property damage. The tank 18 in. diameter, 5 ft long, was set vertically with the head at the bottom convex to pressure. The top, concave to pressure, failed. The head was $^1/_4$ in. in thickness with a $^3/_4$-in. skirt. The welding contact after failure showed it to have been less than $^1/_8$ in.

This led to much correspondence and study by the Boiler Code Committee as well as to information from California of four other failures of inserted heads. The Committee authorized a letter to Mr. Page asking for full data of design and construction of the tanks which failed, especially the attachment of the heads and the way in which failure occurred. The answer of the Boiler Code Committee of Dec. 12, 1932, noted that the ruptured vessel showed a construction so foreign to the letter and spirit of the Unfired Pressure Vessel Code that the failure did not indicate that present Code requirements were incorrect. The construction used was not sanctioned by the Code. No failure in a welded vessel constructed in accordance with the requirements of Fig. U-17 of the 1932 Code and of Pars. U-73 and U-75 had been reported to the Boiler Code Committee. The letter requested any further information which could be sent.

Mr. Page later referred to proposed revision of Pars. U-69 and U-70 (*a*).

A conference was held between Mr. Page and two members of the Boiler Code Committee, R. E. Cecil and C. W. Obert, during the meeting of the National Board of Boiler and Pressure Vessel Inspectors in New York, Oct. 17 and 18, 1933. The discussion of the problems resulted in revising Fig. U-17 of the 1932 Code (Fig. U-18, 1935 Code) so as to make the distance $2t$ of the figure that from the point of tangency as shown in Fig. U-18 with a minimum of $^1/_2$ in.

Following the settlement of this question came the report from Mr. Page of the failure of a casing-head gasoline storage tank in the refinery of a large oil company causing the loss of 10 lives. Then the Industrial Accident Commission was requested to supervise the installation and operation of unfired pressure vessels, particularly those of the oil and other industries handling or treating inflammable material. Mr. Page requested the recommendations of the Boiler Code Committee in the consideration of proper rules. A letter was sent calling attention to the API-ASME Code and the ASME Unfired Pressure Vessel Code as well as consideration of the safety factor.

It was reported at the meeting of Feb. 16, 1934, that F. A. Page had been advised by his chief that it would be well to follow the ASME Code because of the limitation of working stress and Mr. Page was informed by the Boiler Code Committee of the elements which should be considered in tank design. Later discussion of California needs occurred at the meetings of March 23, 1934.

There were no further references to the California activities in 1934 and 1935.

Smoke-Tunnel Testing

FUTURE air-pollution problems are being solved before they arise by New York University engineers, by means of smoke-tunnel tests on models of proposed new industrial plants and the homes, factories, fields, and woods around them.

Dr. Harold K. Work, director of the Research Division of New York University's College of Engineering, and R. C. Roe, president of Burns and Roe, Inc., announced that recently completed terrain-model tests will make it possible to increase the generating capacity of the Hudson Station of the Rockland Light and Power Company, at Tomkins Cove, N. Y., without increasing air pollution.

The Hudson Station now consists of two 22,000-kw generating units, and expansion plans call for the installation of a 66,000-kw unit. Burns and Roe, consulting engineers to the power company, sponsored a series of smoke-tunnel tests to determine how the new unit would affect atmospheric conditions in the residential section surrounding the plant.

Scale models of the generating station, the proposed addition, and the entire neighboring community were tested in the Research Division's low-speed wind tunnel, especially designed for air-pollution studies. The behavior of the smoke and gases from the plant's stacks was studied under a variety of wind-speed and wind-direction conditions. The effect of different stack velocities, stack designs, and building contours was determined.

According to Mr. Roe, these test results indicated that it can be confidently predicted that there will be no worsening in air-pollution conditions when the new unit goes into operation. Also during the smoke-tunnel tests certain modifications to the existing stacks were worked out that will improve present conditions appreciably.

The modifications, Mr. Roe said, will consist of extensions to the existing stacks and the use of a tapered stack design, which will result in greater stack gas velocities and thus a higher trail effect.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

1953 Manpower Program

THE serious shortage of engineers and scientists which has hampered industrial production and expansion for the past two years will continue to retard, during 1953, attainment of full output of civilian and defense materials, both of which are sorely needed to maintain our defense effort and to help stabilize U. S. civilian economy.

These views were set forth by T. A. Marshall, Jr., Mem. ASME, executive secretary of the Engineering Manpower Commission of Engineers Joint Council, during a recent meeting with manpower authorities. Right now, he declared, there is a need for 40,000 new engineering graduates for industrial and civilian governmental needs alone without considering the needs of military services or education. The grim facts on engineering graduates for the next four years are estimated in 1953 at 23,000; 1954 at 19,000; 1955 at 22,000; and 1956 at 29,000.

To combat this continuing shortage of technical manpower, announcement of the EMC program for 1953 reveals that the Commission will:

1 Attempt to secure better utilization of engineers and scientists by industry and government. Considerable progress has been made during the past year in calling to the attention of governmental agencies cases of malutilization of engineers. In addition to continuing to work toward better utilization of engineers by Government, particularly in the military services, it is planned to step up activities on the utilization of engineers in industry. More specifically, EMC will: (*a*) Strive for better allocation of engineers between the military, educational, and industrial parts of our economy in order to maintain an optimum of activity in all three. (*b*) Continue to advocate the establishment of committees or panels to advise the Selective Service System, Department of Defense, Office of Defense Mobilization, and others on the allocation and use of engineering and scientific manpower. EMC has offered and will continue to offer its assistance and that of its supporting professional societies, representing engineers and engineering educators, toward the establishment, under professional control, of advisory groups of this nature. (*c*) Study the feasibility of commission in the military services of engineers as such, and the use of technical institute graduates, and those not completing engineering courses in the colleges, rather than engineering graduates in billets and jobs requiring the capacity and training of technicians only. These should aid in reducing the malutilization of engineers in both government and industry.

2 Press for determination of the requirements for engineers as such in the various military services. This would include determining the effect of ROTC policies on the supply and utilization of engineers.

3 Initiate an active program to encourage and facilitate the return to engineering occupations in industry of those engineering graduates who, in slowly increasing numbers, are leaving military service after varying periods of active duty.

4 Recommend amendment of the Armed Forces Reserve Act of 1952 (P.L. 476). Provision should be made for a properly balanced allocation of those persons having special proficiency and experience. These persons should be distributed to meet the needs of military mobilization and at the same time preserve civilian activities required to support mobilization, and otherwise necessary in the national health, safety, and interest.

5 Continue the program to interest qualified high-school students in careers in engineering and science. In this area, EMC will: (*a*) Continue the "Engineers Wanted" campaign of The Advertising Council, (*b*) Support the local activities of the Engineers' Council for Professional Development, (*c*) Encourage such organizations as the Future Scientists of America Foundation. (*d*) Work toward securing adequate high-school curricula in science and mathematics.

Assistance will be given to such organizations as the Future Scientists of America, but it is contemplated that this assistance will be of informational and advisory nature rather than financial.

6 Provide assistance to various activities requiring information on the engineering-manpower situation. This will include aid in obtaining outstanding and well-qualified persons as speakers.

To carry out these objectives, close contact will be maintained with such agencies as the U. S. Office of Education, the National Security Resources Board, the National Research Council, the ODM Committee on Specialized Personnel (Flemming

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rate, 40 cents per page.

Committee), the Selective Service Advisory Committee, the Armed Services Committees of the House and Senate, the American Council on Education, the Defense Manpower Administration, as well as the recently formed Citizens Committee on Utilization of Manpower in the Armed Services (Sarnoff Committee), N.A.M. Manpower Committee, Manpower Committee of ACS, National Manpower Council of Columbia University, National Science Teachers Association, the newly organized Scientific Manpower Commission, and others concerned with manpower policies and problems affecting engineers and scientists.

Whenever possible, co-ordination will be sought from those in a position to co-operate with the EMC in advancing the purposes of the commission.

High-Speed Camera

A NEW camera, believed to be the fastest of its kind ever constructed, has been developed by the staff of the University of California's Los Alamos Scientific Laboratory, Los Alamos, New Mex., it was announced recently. Capable of photographing explosive phenomena at speeds up to 3,500,000 frames per sec (about 150,000 times as fast as the usual picture one sees at the movie theater), the camera is of the high-speed, continuous-writing, rotating-mirror type. Details of the new camera were revealed at a meeting of the Society of Motion Picture and Television Engineers in Washington, D. C.

The camera is primarily useful for the photography of high-speed events that are self-luminous or that are illuminated by very intense explosive light sources using an argon atmosphere. Unlike conventional motion-picture cameras, in which the film is moved and the lens is fixed, the new camera incorporates two stationary film strips and a moving optical system. The element which makes possible the remarkably high exposure speeds is a small, thin, two-faced mirror which rotates at 10,000 rps. The image of the object being photographed is relayed from the surfaces of the mirror to successive positions on the film strips through a series of lenses. The "shutter" of the camera consists of a small block of plate glass which is shattered and rendered virtually opaque within a few millionths of a second by a shock wave from a high-explosive detonator. The shutter differs from an ordinary camera shutter in that it is initially "open," remains so during a complete sequence of 50 to 100 pictures, which are taken in 1/20,000 sec, and then is "closed."

Hot Laboratory

MUCH has been written about the nuclear scientists who work daily with radioactive materials too "hot" to handle, but it is always interesting to review how they have been able to solve many of their problems by using one of the Atomic Age's unique "tools"—the "Hot Laboratory."

One such group of scientists is at work in the Bettis Plant, Pittsburgh, Pa., of the Atomic Energy Commission. Operated by the Westinghouse Atomic Power Division, this plant is engaged in two of the nation's atomic projects—construction of the atomic power plant for submarine U. S. S. *Nautilus*, and development of another nuclear reactor for a large vessel, such as an aircraft carrier. Both projects are being conducted for the U. S. Navy and the Atomic Energy Commission.

A major problem in the construction of nuclear reactors is that of handling radioactive materials during tests and laboratory analyses. For safety purposes, this testing is done almost completely by remote control in a building known as the "hot lab."

FIG. 1 OVER-ALL VIEW OF HOT LABORATORY

FIG. 2 HANDLING RADIOACTIVE SPECIMENS

There are five "hot spots," or cells, in the Westinghouse hot lab and these are separated from the main working area by a thick concrete and lead wall. In the cells themselves—each separated from the other by a thick steel wall—are testing devices designed especially for the lab's operations.

In Fig. 1 scientists and technicians are shown testing and observing radioactive materials by remote control from behind three to five feet of concrete and lead walls. Layers of thick plate glass, separated by oil protect them from the deadly radiation emitted by the hot materials in cells on the other side of the wall. Periscopes and telescopes are used to review the radioactive objects at close range.

Radioactive specimens, too hot for human hands to handle, get special attention in one of the cells, Fig. 2. Using remote-control equipment, an engineer operates a milling machine to cut the end off a container holding radioactive mate-

FIG. 3 SUPERSENSITIVE BALANCE

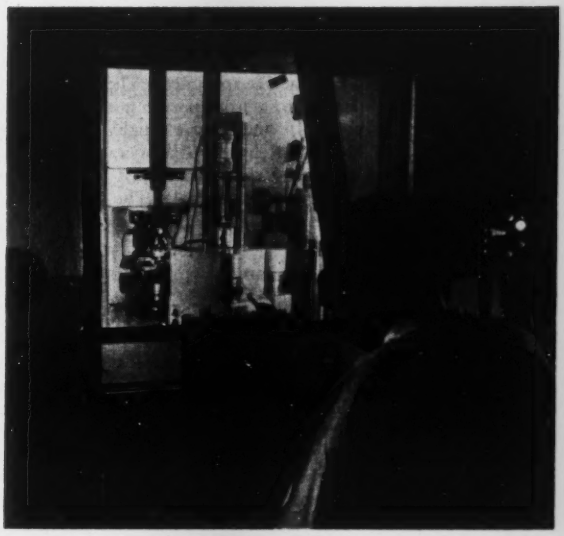

FIG. 5 LONG-RANGE MICROSCOPE

FIG. 4 IMPACT TESTING OF RADIATED SPECIMENS

FIG. 6 REMOTE-CONTROL PHOTOGRAPHY

rial to be tested. Once the end of the specimen container is removed, the untouchable objects are dropped into a tray, picked up by another, but smaller, manipulator and carried to another cell where physical and mechanical properties will be tested. The periscope at the left of the picture has a motorized head and can view the entire cell at close range. The special window is 36 in. thick and is made of layers of plate glass separated by an oil which has the same refractive index, or light-bending quality, as the glass.

The device behind the thick glass-oil window in Fig. 3 is called a "Gram-atic Balance" and is operated completely by remote control. The balance is so sensitive that it is capable of weighing the amount of lead used to write the word, "Gram-atic," or 11-millionths of a pound. Here, a technician is weighing a specimen which has been subjected to radiation to find out how much of a weight change has taken place.

To find out how much of an impact a material will stand after it has been exposed to radiation, a specimen is struck with a hammerlike instrument shown in the cell in Fig. 4. Here, a technician gets set to release the "hammer" and allow it to strike a small specimen held in position at the lowest point of the hammer's swing. Small manipulator "claws" are standing nearby ready to pick up the specimen and carry it to another device where it will be examined for "impact strength."

Exposure to radioactivity affects the hardness of a material. In Fig. 5 an engineer, using a "long-range" microscope, is measuring the size of an indentation made on a specimen. The specimen is viewed by looking through the periscope that is linked to the microscope in the cell by an optical system 17 ft long. In the foreground of the cell is a mounting press upon which the hot material is prepared for observation under the microscope. All of these operations, including focusing and

lens changing on the microscope, are done by remote control.

In Fig. 6 a technician is shown operating a specially designed camera to photograph the microstructure, or the "atomic make-up" of a radioactive specimen. The camera-periscope arrangement is linked to a high-power microscope that has a lineal light path of 14 ft and that is capable of magnifying an object in its field 2000 times. All operations in this special photography, including the changing of focus, lenses, and specimen, are done by remote control. The pictures will tell the scientists if any change has taken place as a result of the specimen having been exposed to radiation.

Industrial Atomic Power

SOME aspects of nuclear power for industry were discussed in an address prepared by Walker L. Cisler and A. S. Griswold, Detroit Edison Company, Detroit, Mich., for the recent Centennial of Engineering banquet held in the Mayflower Hotel, Washington, D. C. Mr. Griswold, who gave the address, pointed out that atomic energy today seems to present two major areas of peacetime application—heat for industrial use and a large series of useful isotopes. The tremendous amounts of heat energy involved seemed to be reasonably well understood. One pound of uranium is said to possess the heat equivalent of 1300 tons of coal. Therefore, if the price of uranium, as sometimes stated, is approximately $35 per lb, the cost of heat released by the fission of uranium, if it can be effectively utilized, will be extremely low.

The challenge to engineering comes in the utilization of the heat of nuclear fission, according to Mr. Griswold. Under ordinary circumstances, a change in industrial processes of the kind contemplated would be undertaken only when the cost of using the new fuel or source of heat is as low as or lower than the cost of using conventional sources of heat. The application of atomic energy to industry on a wide-scale basis, therefore, depends upon the ability of engineers to bring the costs within reason.

Heat is used in many different ways in industry, particularly in metallurgical and chemical processes, Mr. Griswold pointed out. The radiation which results from nuclear fission will be a difficult and complicating factor in the direct application of the heat produced by fission to these processes. Where heat is required in the form of steam, the use of atomic fuels ultimately may be practical.

The other extensive use of heat in industry is in the generation of electric power and it is toward this application that our greatest efforts have been devoted, he said. Scientists have developed types of nuclear reactors which can be used to produce very large amounts of heat. Up to the present, only laboratory and experimental installations have actually been built.

While much of the theory concerning reactors and the release of heat during nuclear fission is known, Mr. Griswold said, no actual steps have been taken toward the construction of reactors for practical commercial application in the generation of electric power. This is because many of the problems involved are as yet unsolved and the cost of producing a reactor appropriate for commercial application now appears to be extremely high.

A number of investigations directed toward solving the technical problems and developing practical installations are being vigorously carried forward, Mr. Griswold stated.

Since March, 1951, the Dow Chemical Company and the Detroit Edison Company have been engaged in a joint study of the feasibility of using the heat of nuclear fission in industry. Recently additional companies have become associated with Dow-Edison in this effort until now a total of 15 separate enterprises are actively engaged in the project. The study, therefore, has the benefit of extensive engineering organizations and experienced business executives. It has been concluded by this group that the use of heat from nuclear fission does appear to be practical but that a great amount of engineering research and development is necessary.

As the starting point in the second phase of this endeavor, what should be called a high-temperature breeder reactor, together with an integrated processing scheme, has been chosen as best meeting the purpose. The proposed reactor system is now the subject of detailed technical study.

The problems which must be solved include the method of recovering the heat generated in the fission of the atomic fuels, the processing and reprocessing of the fuels, the processing of the excess fissionable materials, disposal of the waste, and the multitude of metallurgical, chemical, and mechanical problems incident to such a development.

As part of the Dow-Edison study, Mr. Griswold revealed, it has been shown that in the Detroit area at least, the investment of approximately $227 per kw of capacity in a reactor could be justified as compared with $77 per kw in the boiler plant of a conventional thermal-electric station. Thus it appears that the investment of $300 to $325 per kw of capacity might be justified in a large thermal-electric station in which the heat would be obtained from atomic fuels as compared with $150 to $170 per kw of capacity now required to construct a large modern coal-burning thermal station. In other areas these values might be somewhat different depending largely on fuel costs.

If a heat power reactor could be built for an investment of $227 per kw of electrical capacity, then the cost of heavy energy delivered to the turbine throttle valve would be equal to the cost of heat energy delivered by conventional coal-fired boilers. This assumes no cost for atomic fuel, and no operating and maintenance expense. With uranium costing $35 per lb, the cost of heat energy would be about 0.013 mill per kwhr—a negligible amount. It is anticipated that the value of by-products produced by the reactor would offset the operation and maintenance costs.

If these conditions can be met—a reactor costing not more than $227 per kw of electrical capacity and the production of excess fissionable material having a market value equal to operating and maintenance expense—then the use of atomic energy for power generation becomes *competitive* and can become *commercially competitive*. And we must recognize, he said, the generation of electric power using atomic fuels cannot be justified, except during a development period, unless the costs are competitive.

It is extremely doubtful whether the first breeder reactor for electric power generation can be built within the cost of $227 per kw, but it is believed that this may be possible after initial experience is gained.

The high investment costs present a serious problem in the event the application of atomic fuels to electric power generation becomes widespread. We would require approximately twice the investment in thermal generating stations we are now experiencing, he said. The electric power industry presently has a high ratio of investment to income. An increase in this ratio could create definite problems in financing.

Mr. Griswold emphasized that there is a further problem concerning whether the development of atomic-fueled electric-power stations should be carried out using governmental funds or private investments. Up to the present time the development in the United States and elsewhere has been almost entirely by governmental agencies. It is believed by some that government should carry on the development and actually develop and build atomic-powered generating stations. There

is the very strong feeling by others, and particularly those who believe in the principle of free enterprise, that the application of atomic energy to industry is a matter of private investment. On the whole, both of these groups feel that the early development of atomic-fueled power stations is of greatest importance if we are to maintain our world leadership.

From the practical viewpoint, atomic energy can be considered as a fuel. If government develops uses for this fuel, Mr. Griswold said, government must invest prodigious sums of money, acquired primarily in the form of taxes, in power-generating facilities. The investments thus created will not appear on the tax rolls and will not contribute their normal share to the tax burden of the country.

If private investment carries the development forward, many important economic conditions will result, he said. First is the matter of investment costs. Private investment is anxious to make new developments but will adopt them only when the costs can be justified. There will be, therefore, the great incentive to bring about engineering advances which will make the use of this new resource competitive with our present conventional fuels. There will be created new industry, new investments which contribute to the advance of our economy through reduced costs, and to the support of our way of life through contributions in the form of taxes. There will be created additional opportunity for investment. Mr. Griswold stressed that this is free enterprise, the way of life upon which our country was founded, and upon which it grew to its present position of world leadership.

Energy and its application long has been recognized as the dominating factor in industrial development. We now have a new and perhaps unlimited potential source of energy and, according to Mr. Griswold, as engineers we have a challenge—a challenge to develop the use of this energy at costs which can be justified and in ways which will contribute to the progress and pre-eminence of our country, and others allied with us.

The Dow Chemical Company and The Detroit Edison Company have accepted this challenge, he said, and are investing their own private funds in the effort to develop competitive methods for utilizing the heat of nuclear fission. They would like to build and operate such an installation, financed by private investment, as soon as possible.

Waste Atomic Gases

WASTE gases as finally discharged into the air, from the Knolls Atomic Power Laboratory at Schenectady, N. Y., are no more radioactive than the normal surrounding atmosphere and in many instances are even less radioactive, according to Joseph J. Fitzgerald, a scientist at the Knolls Atomic Power Laboratory which is operated by the General Electric Company for the Atomic Energy Commission.

Speaking before the Fifth Annual Conference on Instrumentation and Nucleonics in Medicine, sponsored by the American Institute of Electrical Engineers, Mr. Fitzgerald described how an atomic-energy laboratory can operate safely in a populated area.

The laboratory is principally engaged in building a prototype atomic power plant for U. S. Navy submarines. Its research involves work with uranium 235 and other elements that release nuclear energy by the process of fission, he pointed out. A constant study is made of the waste gases discharged into the air, in order to afford the maximum protection of the neighborhood, he added.

These gases are discharged through a 100-ft stack, and are constantly monitored to make sure that the concentration of radioactive material is kept well below permissible limits.

Constant air monitors are located at selected sites to check the radioactive concentrations at various points near ground level. Plant samples also are analyzed on a regular schedule to evaluate the accumulation of radioactivity on vegetation.

Describing the safety operations, he said that the waste radioactive gases and smokes from the working areas are first passed through a "scrubber," in which a caustic solution washes out the larger radioactive particles as well as the more volatile components. Next, they go through a high-efficiency filtering system, which removes more than 99.9 per cent of the small amount of radioactive material left. The air that remains is diluted, from 1000 to 10,000 times, with filtered air from the ventilating system of the building, and then is discharged through the stack, the scientist said.

Normal atmosphere contains measurable but harmless quantities of radioactive elements, and these produce radioactive particles which are also removed by the filtering process.

As a result, he said, in many instances the effluent from laboratory stack is cleaner radioactively than the atmosphere.

Clear Image Lens

A CLEAR image lens, said to be powerful enough to give vision to about half the estimated 150,000 partially blind persons in the United States, was described at the annual meeting in Bangor, Me., of the Maine Optometric Association by Dr. William Feinbloom, associate in optometry at Columbia University, New York, N.Y.

This new device, he reported, is a member of the microscopic-lens family, and may offer hope to many of the partially blind having as little as two per cent vision. These partially sighted persons, he said, who include many children doomed to a life of Braille, have until now been classed with the blind.

Dr. Feinbloom said that the new lens, the result of five years of intensive research and clinical tests, is the first device removing all the blur optically possible from the eyes of the partially blind.

For the first time the principle of aspherical surfaces is employed as an aid to the human eye, he explained. These surfaces are departures from the spherical surfaces found in ordinary spectacles or magnifying glasses. Thus, instead of being curved like a ball (spherical), the new lens is slightly flattened or parabolic (aspherical) toward the edges.

He pointed out that patients who never before viewed television clearly, can now see the TV screen with maximum clarity. They can read newspapers, magazines, and books, while without the lens they have had to depend on the eyes of others. The new lens should mean a return to normal work and living to many of those now classified with the blind, he declared.

The new lens, he revealed, also has been successful with persons suffering loss of vision because of advancing age, particularly defense workers engaged in high-precision work.

He cited clinical results with more than 400 patients who have used the lens for one to five years.

Based on their ability to read ordinary newspaper type, he reported, there have been good results with the new lens in over 90 per cent of the cases. Many had eye defects due to accidents, disease, or birth. Others were postoperative cataract patients, or had optic atrophy following brain-tumor surgery. After being fitted with the new clear image lens, most of these patients who had been treated as blind, now carry out their daily routines without assistance.

Demonstrating the new lenses, Dr. Feinbloom pointed out that they can be worn like ordinary glasses, although they consist of a series of two or three lenses set about $^1/_8$ in. apart. Total thickness of the resulting lens is about $^7/_{16}$ in.

The new lenses in the lower powers, Dr. Feinbloom described, consist of an air-separated doublet (two lenses) of deep curvature. In the higher powers, the lenses consist of an air-separated triplet (three lenses). In each case the front lens acts as an objective of the system and the rear one or two lenses as the eyepiece.

Instead of the image being made to focus close to the eye, as in the case of an ordinary magnifying lens, here the image is made to focus at infinity. This insures that there is no strain on the eye, or harm to the little vision the patient still retains.

Rubber Conveyer Beltroad

A $4^1/_2$-MILE rubber conveyer beltroad, replacing boats, to transport iron ore and limestone from harbor to industrial processers in the Cuyahoga Valley could be Cleveland's solution to its perennial, multimillion-dollar program of keeping the narrow, twisting Cuyahoga River open to ore-boat traffic.

After studies of more than a year, engineers of the B. F. Goodrich Company, Akron, Ohio, believe such a beltroad, stretching up the Cuyahoga Valley, could be built in a year at an estimated cost of $6,000,000 for the conveyer and drive equipment. Dock and loading facilities, as well as rights of way, would be additional.

The report was made public recently at a meeting of the Cleveland Port and Harbor Commission. The idea of a Cuyahoga Valley beltroad was first advanced to B. F. Goodrich in 1950, by Charles F. Cousins of Cleveland.

The report states that the growth rate of Cleveland's steel industry indicates that ore and limestone deliveries must be increased to satisfy the needs of the future. Today the Cuyahoga River has a throttling influence on shipping and is the weakest link in a chain of distribution that moves ore from the iron range to Cleveland steel mills. The proposed beltroad could carry all the iron ore and limestone needed in Cleveland now or in the foreseeable future.

According to the report, the terrain of the Cuyahoga Valley is ideal for such a conveyer system. Pointing out that a beltroad for the Cuyahoga Valley posed no new engineering problems, B. F. Goodrich refers to other long-distance overland beltroads with which that company has been associated and which are working realities today. Iron ore from the iron range, the report says, gets started on its trip to Cleveland by riding rubber conveyer belts out of the mines.

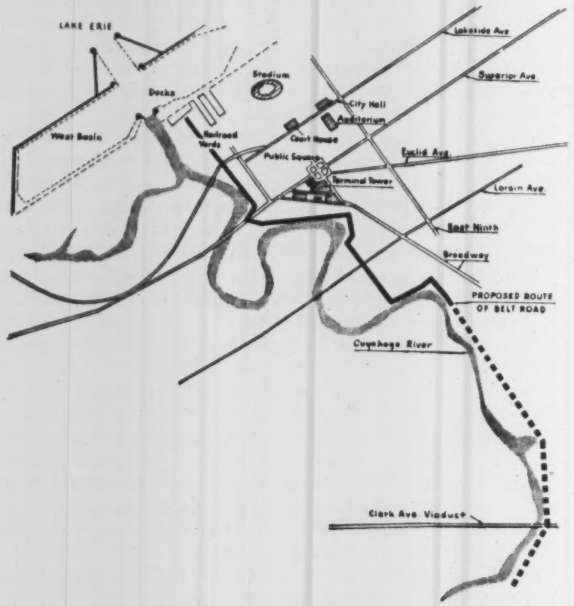

FIG. 7 ONE POSSIBLE ROUTE FOR THE $4^1/_2$-MILE BELTROAD PROPOSED BY B. F. GOODRICH COMPANY FOR THE CLEVELAND AREA

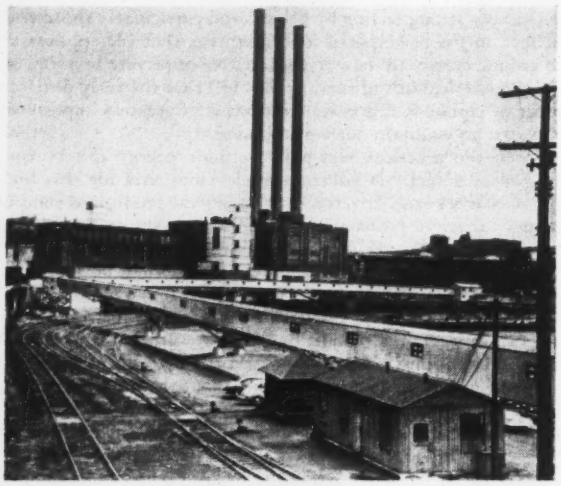

FIG. 8 ARTIST'S DRAWING ILLUSTRATES HOW THE BELTROAD COULD MAKE 90-DEG CHANGES IN DIRECTION AS IT FOLLOWS THE CUYAHOGA RIVER UP THE VALLEY

Company engineers believe that a Cuyahoga Valley beltroad might well open a new era of industrial expansion for Cleveland, with resulting collateral benefits in the way of additional jobs and larger payrolls.

The company's proposal suggests that a conveyer-belt system could accept iron ore and limestone directly from ships docking at new waterfront facilities. Cargos could also be unloaded into a stockpiling area at the same location. The main beltroad would provide a smooth, continuous flow of materials from lakefront to steel plants. Spur lines would carry materials from the main beltroad to the stockpiles of individual industrial users.

The report points out that ore boats lose valuable time in the slow passage up the Cuyahoga River and said that these vessels could be put to more profitable use if operated full time on the Lakes alone. With the beltroad a reality, ore boats could unload at the lakefront and return immediately for more cargo.

Elimination of the time-consuming Cuyahoga River passage, the engineers believe, would, in effect, multiply the size of the fleet by making it possible for each boat to make extra trips to Cleveland each season, carrying more ore and limestone. To further increase ore deliveries, shipping companies could use larger, more efficient boats. The narrow Cuyahoga River now bars passage of the larger boats.

In its proposal, B. F. Goodrich cited the following other advantages a beltroad could bring to the greater Cleveland community:

1 Relief of traffic congestion. Raised bridges over the Cuyahoga River act like tourniquets on Cleveland's traffic pulse. Operation of the beltroad would clear the Cuyahoga River of both ore and limestone carriers. In addition, a pipe line for petroleum products could be an integral part of the conveyer structure, thus clearing the river of tankers. Numerous bridges must now be raised for every ore or limestone carrier which passes up the river. With a beltroad in operation, traffic

planners could utilize highways more effectively to speed the flow of traffic into and out of the city.

2 Smoke reduction. With added industrial space opened in the upper valley by a beltroad, industry can move in that direction, thus reducing the smoke problem in the heart of Cleveland. Beltroads are smokeless. They replace river traffic which adds to the smoke problem.

3 In case of enemy attack. Repairing damage to a beltroad is a matter of hours, not days or weeks as may be the case to reopen a river to traffic once passage is obstructed.

Heating Panel

DEVELOPMENT of an electric radiant-heating panel only 1/16 in. thick which can be cemented to the ceiling like wallpaper has been announced by United States Rubber Company, New York, N. Y. The new panel is a sheet of conductive rubber that is the heating unit, sandwiched between layers of thin plastic and aluminum foil.

Complete radiant heating for an entire house or for a single room is possible with the panels, the company states. They are particularly useful for homeowners who add a new room or who want to supplement existing heat in such places as a den, expansion attic, or garage.

Called Uskon, the panels are extremely light, weighing only 6 oz per sq ft. A special adhesive bonds them to ceilings of plaster, sheetrock, or similar smooth material. Occasionally, molding is used in conjunction with the adhesive. The number of panels required is determined by climate, insulation, and other factors, but generally, Uskon does not cover the entire ceiling.

Where electricity is available for 1 1/2 cents a kwhr or less, the cost of operation is comparable with that of other fuels.

Three sizes of panels are available, 4 × 6 ft, 4 × 4 ft, and 3 × 4 ft, and both outer surfaces are covered with aluminum foil to keep out moisture. The panels are rated at 22 watts per sq ft (75 Btu) and are available for either 115 or 230 volts. Because of the absence of abnormally high temperatures at concentrated points, hazards from burns and scorchings are eliminated.

Homes with Uskon heating panels have much more living space, because there are no radiators, wall heaters, chimneys, furnaces, boilers, ducts, or valves. Walls and floors are left completely free, and there is extra room for furniture and decorations.

Scientific analysis indicates that radiant heat in the ceiling is comfortable and healthful because of its uniformity and freedom from drafts, and because it is the nearest approach to the natural heat of the sun. Surface temperature of the ceiling

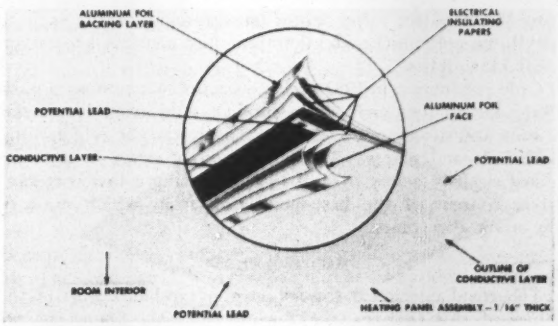

FIG. 9 CONSTRUCTION DIAGRAM SHOWS THAT USKON PANELS ARE VERY THIN SHEETS OF CONDUCTIVE RUBBER SANDWICHED BETWEEN LAYERS OF THIN PLASTIC AND ALUMINUM FOIL

FIG. 10 USKON HEATING PANELS ARE EASILY ATTACHED TO CEILINGS BY A SPECIAL ADHESIVE

panels averages about 100 F, and the heat rays warm the floor and other objects in the room without heating the air.

It is pointed out that excessively dry air is avoided, and the humidity approaches that of the outdoors. There is said to be no fuel soot, no fumes, and virtually no dust in circulation. Individual room heating may be operated by thermostatic control, if desired.

Panels can be attached to ceilings, without any cutting, rebuilding, plastering, or structural changes. They are then painted with conventional flat interior decoration.

The new-type panel is ideally suited for expansion attics that are to be made over into living quarters. An installation in a Levittown, L. I., home with an expansion attic of about 400 sq ft, cost approximately $300. The attic had been converted into two rooms and a bath.

A home now being completed in Milan, Tenn., gives an idea of the installation cost where Uskon panels are used as the sole heating source. This two-story home is in the $25,000 price bracket, with three bedrooms, and two baths. Cost of the Uskon installation in this frame building with a stone and brick veneer will be about $1200 for 36 panels.

Mineral Production

ACCORDING to the U. S. Bureau of Mines, the mineral industry of the United States continued to operate in 1952 at the highest production rates in history.

The Bureau estimated that total value of mineral production in 1952 was approximately $13.5 billion, the same as in 1951. There was a slight decrease in physical volume of production, matched by a slight increase in average mineral prices. In terms of individual minerals, a significant decline in coal production was balanced by increases in most other mineral items.

BITUMINOUS COAL

Production of bituminous coal and lignite in 1952 was estimated at 465 million short tons, a 13 per cent decrease from 1951 output. The lower production was the result of steel strikes, declining overseas exports, and decreasing domestic consumption. The general outlook, the Bureau reported, is not favorable to any recovery in production this year.

The average value of soft coal at the mine was about $4.95 per short ton last year, a slight rise over 1951.

Estimated production of 40 million short tons of anthracite

coal in 1952 was a decline of about six per cent from 1951, attributable mostly to lower overseas exports.

PETROLEUM PRODUCTION

Crude-petroleum producers chalked up another record year with an output of approximately 2.3 billion bbl—equivalent to 6,260,000 bbl daily—a slight gain over 1951. This output was worth an estimated $5.8 billion at wells (an average of $2.53 per bbl) and accounted for over 40 per cent of the total value of United States mineral production in 1952.

Marketed production of natural gas was estimated by the Bureau at 8100 billion cu ft, nine per cent more than in 1951. The average value of gas at wells rose slightly to about 7.4 cents per thousand cu ft.

Production of natural gasoline was estimated to have risen two per cent to about 121 million bbl, with the average value remaining unchanged. Output of liquefied petroleum gases expanded more significantly—by an estimated 16 per cent—to roughly 100 million bbl. Stocks of L-P gases increased by about 1.5 million bbl during the course of the year.

NONMETALLIC MINERALS

Production of nonmetallic-mineral raw materials, which go to the construction, chemical, fertilizer, ceramic, and many other industries, increased about eight per cent in total value between 1951 and 1952, largely as the result of higher values for stone and cement. Among the nonmetallics showing physical increases of five per cent or more were sand and gravel, stone, ground sand and sandstone, bromine, and potash.

A small gain over 1951 brought 1952 cement production to nearly 250 million bbl. New plants at Brandon, Miss., Baton Rouge, La., and Maryneal, Texas, produced large quantities, and a plant at Bunnell, Fla., was reported near completion. The average mill value, according to reports from producers, was stable throughout the year at about $2.55 per bbl.

Fluorspar and gypsum production dropped off from 1951, the decline in fluorspar shipments from domestic mines occurring in the face both of a record consumption of fluorspar and increased Government stockpiling. Imports of fluorspar, on the other hand, established a new record and appeared for the first time to have exceeded domestic production. Output of gypsum and gypsum products declined sharply in the early months of 1952, particularly in the eastern States. It appeared, however, that a large part of the loss was made up in the latter part of the year and that final figures would show a production which, while below 1951, would approximate that of 1950.

IRON-ORE PRODUCTION

The supply of iron ore in 1952 was reduced by strikes which led to the loss of two months' production during the peak of the season. Extraordinary effort on the part of the producers, however, and the new cargo capacity added to the Great Lakes carrier fleet, ameliorated the effects of the shutdown, with the result that fairly adequate stocks of ore were available for Lower Lake consumers' winter needs.

Except for nickel, a marked improvement was reported in supplies of the ferro-alloy metals. The international allocation plans for both cobalt and tungsten were discontinued at the end of the year.

The manganese situation changed radically in 1952 because of the sharp increase in imports coupled with the drop in consumption resulting from strikes in the steel industry. Imports were sufficient to permit a rapid recovery of manganese-ore stockpiles in the hands of the alloy producers. Similar factors, plus increased domestic production, also led to a marked improvement in tungsten supply. Domestic production of chromite increased by 35 per cent and imports by 13 per cent.

Despite the increased supply of nickel provided by slightly higher production in Canada and resumption of operations in Cuba, and despite a lower rate of Government stockpiling, there was a scarcity of the metal in terms of industry requirements, and international allocation was continued. Similarly, although production of molybdenum increased by about 13 per cent and consumption declined slightly, the combined demand for domestic consumption, export, and national stockpile continued to exceed the supply, and both domestic and international allocation were retained.

NONFERROUS METAL IMPORTS

There was no further increase in domestic production of copper in 1952, despite the continuing heavy demand. Heavy receipts in the latter half of the year resulted in copper imports which were substantially higher than in 1951, but total supplies, nevertheless, continued to be inadequate for all defense and civilian requirements. Copper continued under complete allocation control domestically, and internationally was governed by the "entitlements to consumption" of the International Materials Conference.

In contrast with copper, both lead and zinc changed from a position of inadequate supply to one of relative plenty, as consumption decreased slightly and supplies were augmented greatly by imports. Domestic mine production of lead was about the same as in 1951, but imports of lead in various forms more than doubled. Mine production of zinc was also little changed, while imports increased by about one third. Prices of both metals declined considerably during the course of the year, and in the later months a portion of the industry was forced to curtail production.

OTHER COMMODITIES

Supported by record imports of bauxite, the aluminum industry turned out 935,000 tons of metal in 1952, an increase of 12 per cent compared with 1951, and a new peak. Power shortages in the Pacific Northwest and in the Tennessee Valley kept output from reaching the scheduled million-ton mark.

Another light metal, titanium, began to blossom into an important new industry in 1952. All commercial production of this metal is based on a process developed by the Bureau of Mines. Output in 1952 of this important military metal was roughly double that in 1951, and by 1956 may be 20 times as great as last year.

During 1952 shipments of monazite, the principal source mineral of the rare-earth group of metals, ceased as the foreign countries producing this material placed restrictions and embargoes on its exportation. Production of monazite in Idaho and of bastnaesite, another rare-earth source-mineral, in California is being developed rapidly to help compensate for the loss. Demand for other minor but strategic metals, such as beryllium, columbium, and tantalum, also continued to exceed available supplies.

Gold production in 1952 declined six per cent compared with 1951, due to less yield of by-product gold from base-metal mining operations and to less output from straight gold mining, both lode and placer. The production of silver in 1952 declined slightly below that of 1951, reflecting a lower average silver content of the base-metal ores from which most of the silver also comes.

MECHANIZATION

The trend continued toward greater mechanization in the mines of this country, the Bureau reported. Improvements were made both in machines and in mining techniques. The practice, pioneered by the Bureau of Mines, of bolting together overhead rock layers continued to replace timbering in coal

mines and was introduced during the year into metal mines as well. This so-called "roof bolting" is not only cheaper, but reduces the hazards of falling rock.

Recovery of manganese from open-hearth slags, a development which would greatly increase the domestic supply of this essential steelmaking ingredient, was advanced by Bureau of Mines experiments during the year. Testing of the smelting operation on a pilot-plant scale is now contemplated by a commercial firm.

Extraction of zirconium metal from its ores, another process pioneered by the Bureau, is being undertaken by several private firms. Owing to its high resistance to heat and radiation, zirconium is an important structural material in the construction of nuclear reactors.

Gas-Turbine Business

BESIDES the great role the gas turbine is playing in the field of aviation, the gas-turbine business in the United States is rapidly expanding, according to company reports received from various parts of the country. After much experimentation, testing, and refinement, actual placing of orders indicates that the gas turbine has now gone beyond the pure development stage and is being widely accepted by both industry and government.

INDUSTRIAL GAS TURBINES

For example, Westinghouse Electric Corporation reports that in September, 1952, a 5000-kw gas-turbine generator began delivering power to the system of West Texas Utilities Company, which covers a wide band 400 miles long from Mexico to Oklahoma. This kilowatt-producing gas-turbine unit sits, almost literally, on top of natural-gas wells (although it can burn distillate oil with ease) and provides much-needed power for the rapidly expanding irrigation systems of Texas.

This unit is the simple, open-cycle type and is but 41 ft long and 12 ft wide. According to the company, it sets new standards for simple construction and accessibility of parts. All hot, high-pressure bearing seals have been eliminated. No bearings are located within hot ductwork. The two bearings are part of the main frame to give maximum rigidity. They are accessible from the ends of the machine. The six combustors project at an angle into the machine, so that their outer ends are exposed. Hence they can be individually removed after their covers have been taken off. The machine is split along the horizontal so that the top cover can be removed as a unit, exposing the entire rotating element.

The unit, being the prototype, was extensively tested before leaving the factory. The thermal efficiency is about one fifth better than the pair of 2000-hp units that preceded it and are now operating in a locomotive. The noise level is low; noise suppressors are unnecessary. Vibration, likewise, is said to be insignificant.

The unit is truly a packaged power plant. All electric connections terminate in a cubicle mounted on the oil reservoir, which, too, is an integral part of the package. All connections are made on the unit. The entire power plant is shipped as two pieces. The generator and gear are one, the gas turbine the other.

Because the unit is compact and lends itself to a self-contained power package, the U. S. Army has purchased an identical unit for installation on railroad cars for use following some disaster or during an emergency. The power plant will occupy one car; the tranformer, switching, protective, and control equipment, a second car.

Late last year tests began on a 5000-hp gas turbine to drive a gas-line compressor. It has a regenerator, which raises the efficiency approximately 20 per cent. It comprises two turbines on separate shafts. One turbine drives the air compressor; the other turbine drives the load. This arrangement allows operation of the power turbine over the entire speed range.

Westinghouse also has a much larger, more efficient gas-turbine power plant under construction for the Public Service Company of Oklahoma. It will deliver 15,000 kw. This unit has two shafts. The high-pressure turbine drives the electric generator and high-pressure compressor. The low-pressure turbine, on the second shaft, drives the low-pressure compressor. In addition to regenerators, the unit has intercoolers between the two compressor stages. This component arrangement gives the unit an efficiency said to be equal to that of a modern steam plant of this size.

LOCOMOTIVE GAS TURBINES

The General Electric Company recently announced that Union Pacific Railroad of Omaha, Neb., has placed an order for 15 gas-turbine electric locomotives with G-E's Locomotive and Car Equipment Department, Erie, Pa.

Delivery on the new order of 15 will begin early in 1954, according to the company.

Addition of the 15 locomotives to the 10 previously ordered will give the Union Pacific 25 of these gas-turbine locomotives.

Commenting on the order, Arthur E. Stoddard, president of Union Pacific, said the 25 locomotives will involve an expenditure of over $14 million and are part of U.P.'s continuing program for fast efficient freight handling on the nation's strategic middle route.

Like its predecessors, the new gas-turbine-powered locomotives will develop 4500 hp, equivalent to an average three-unit diesel-electric freight locomotive. The new units will be about 83 ft long and will pull a heavily loaded freight train at speeds up to 65 mph.

NAVAL GAS TURBINES

Solar Aircraft Company, San Diego, Calif., announced the receipt of a large contract from the U. S. Navy to equip a group of naval vessels with gas-turbine engines.

The company has received Navy contracts approximating $2 million for two types of gas-turbine engines. One group of constant-speed-type turbines will be used to drive electric generators on shipboard. A similar gas turbine, but with variable-speed output, is under development by Solar for the Navy and will be used for propulsion of small craft.

Both turbine types are in the 500-hp class, and the design is called by Solar its "Jupiter" gas-turbine engine. Solar also has designed and manufactures the 45-hp "Mars" gas-turbine engine, which is being furnished to the Navy to drive shipboard fire-fighting pumps. Recently Solar delivered to the Air Force an experimental Mars engine equipped with generator, for supplying auxiliary electric power aboard aircraft.

The original version of the Jupiter engine, first announced late in 1951, was the first gas-turbine engine ever installed in an American naval ship. It was designed to drive an electric generator to provide emergency power on shipboard. The lightweight, compact engine powers a 250-kw generator.

In the Jupiter gas turbines just announced, the basic engine, controls, and reduction gearbox together weigh only 800 lb. The unit is 6 ft long, and both height and width are less than 3 ft. These gas-turbine engines for driving generators, it is said, can replace diesel units of over four times their size and weight, a factor of great importance on fast Navy ships where constant effort is being exerted to reduce the weight and volume of equipment.

The company stated further that it is studying many potential

civilian uses for the gas turbines, such as powering helicopters, small boats, land vehicles, pumps, compressors, and industrial equipment. Gas turbines, in general, weigh much less per horsepower than gasoline or diesel engines, are more compact, and are expected to have lower initial and maintenance costs.

50,000-Lb Drop-Forge Hammer

A STEAM drop-forging hammer rated at 50,000 lb, was recently completed and shipped by the Erie Foundry Company, Erie, Pa., to a prominent drop-forging producer in the United States. This hammer is reported to be the largest steam drop hammer installed in this country, and is probably the heaviest hammer of this type in the world. Equal in rating to three hammers built by Erie Foundry for export just prior to and during World War II, the present hammer is much more rugged than its predecessors, and embodies many refinements in design which Erie has learned from the construction and operation of these earlier machines.

The shipping weight of the completed hammer, without dies, is in excess of 800 tons. When erected on its foundation the hammer extends 16 ft below the floor and approximately 30 ft above the floor.

Despite the immensity of this machine it is easily controlled by one man using a foot treadle or hand levers. The hammer presently will be used to add to America's productive capacity for Air Force equipment, but eventually its efforts will be turned to producing other parts impossible of production on the largest sizes of equipment previously available.

This giant drop hammer features a lubricating system of unusual design for lubricating the guide "Vs." The distribution valve is of a new counterbalance type which permits great sensitivity of control. A key between each of the frames and the sow block keeps frames firm and prevents scale from working under the frame seats. The housing bolts are vertical. The bottom cylinder head is integral with the cylinder. It is turned outside to serve as a huge dowel between the cylinder and the tie-plate. The pockets for the gland bolts are machined from the solid in the cylinder head.

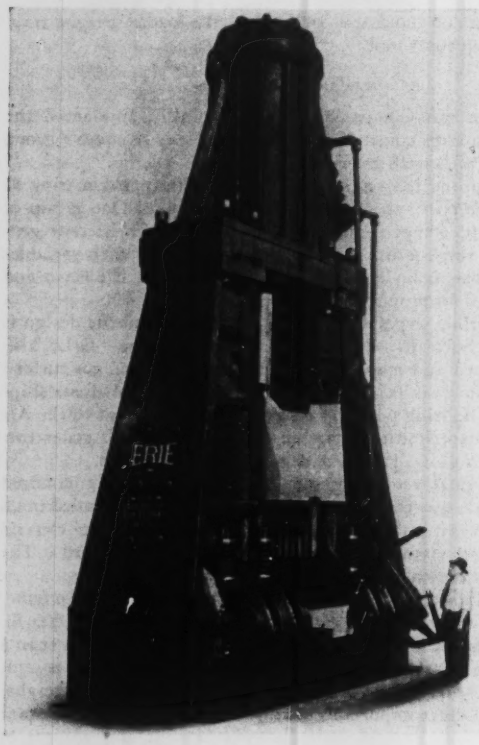

FIG. 11 NEW 50,000-LB STEAM DROP-FORGING HAMMER

Parachute Testing

A UNIQUE program of research dealing with the free-fall tendencies of parachutes, is being carried out in Goodyear Aircraft Corporation's airship dock, at Akron, Ohio. It is said to be the largest building in the world without interior supports.

Under terms of a contract with the Equipment Laboratory of the Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, a staff of engineers from Goodyear Aircraft's research and development department has spent considerable time drop-testing the latest military and civilian-type parachutes from the ceiling of the 200-ft-high airship dock. The building provides an atmosphere free of wind currents and also an unusual amount of unobstructed height and floor space.

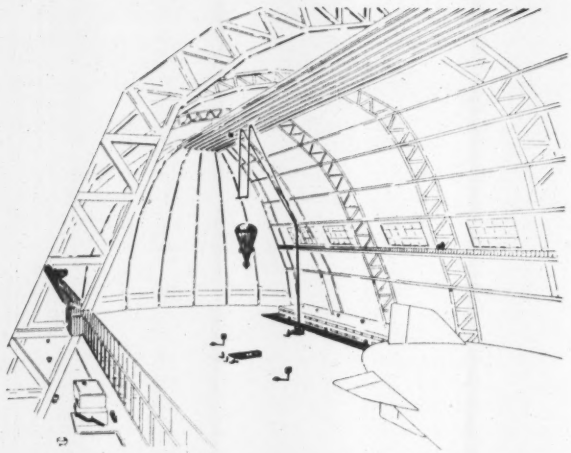

FIG. 12 ARTIST'S DRAWING SHOWS PARACHUTE DROP-TEST PROCEDURE IN HUGE GOODYEAR AIRCRAFT CORPORATION AIR DOCK

(Cameramen positioned on catwalks along opposite sides of building photograph parachute as it falls. Tests made at night, with small lights pinioned to chute shrouds and suspended load, enable cameramen to track free-fall tendencies of parachute on negative. Signs on floor help mark negative for final analysis. Note system of cables used to hoist chutes, which are released automatically. Entire operation is centrally controlled.)

Purpose of dropping the large parachute models is to compare such properties as flight path, stability, weight-carrying ability, and opening characteristics for various types of parachutes. Parachutes being tested include such types as the standard flat-circular parachute in common use today, the famous ribbon and guide-surface parachutes developed by Germany during World War II, and some of the latest Air Force designs of recent development.

Drag and stability characteristics of parachutes are determined by a series of photographs taken as the parachute descends from the ceiling of the airship dock to the floor.

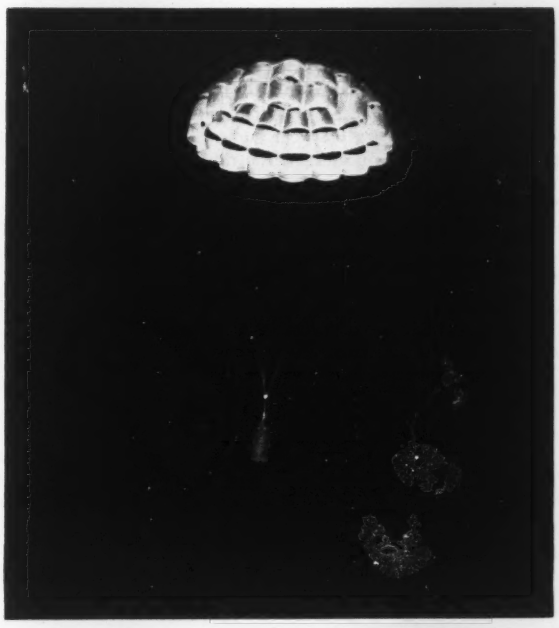

FIG. 13 RING SLOT PARACHUTE, PHOTOGRAPHED BY FLASH CAMERA AS IT MAKES 175-FT UNOBSTRUCTED FALL INSIDE AIR DOCK

In the past, full-scale drop-tests of parachutes have been made from airplanes at considerable expense to scientific agencies. Many model drop-tests have in the past been made from outdoor tower installations and inside elevator shafts or silos, but the results were not as accurate and efficient as those obtained through use of the giant airship dock.

This test setup also has been used for the investigation of tow-target recovery methods and development of instrumentation systems. Indications are that other similar applications can be performed efficiently using the present methods.

Canadian Hydro Progress

A RECENTLY issued review presents, for the year 1952, the results of a regular annual survey which is conducted by Canada's Water Resources Division, Department of Resources and Development. While primarily concerned with progress in the development of Canada's water powers, this review also touches on other phases of electrical power production and distribution. Effective co-operation in the assembly of information is received from provincial authorities and from power-producing and distributing organizations located throughout the country.

According to the survey, a new record was established in 1952 in the total capacity of new hydroelectric generating units completed during the year, although not in the net increase in the total of installed capacity of hydraulic plants in Canada. The record-high total of 1,064,600 hp of new hydraulic turbine capacity was brought into operation but, allowing for dismantling of old plants and list adjustments, the net increase is reduced to 961,726 hp. However, the latter figure is only slightly below the previous record of 988,675 hp which was set in 1943 when the huge Shipshaw plant of the Aluminum Company of Canada was completed on the Saguenay River. In 1952 new capacity was more evenly distributed across the country, although the greater portion was located in the Province of Quebec. The new projects which have been undertaken in rather remote regions serve to enhance the potential value of other undeveloped sites which only recently appeared to be located so distantly from centers of population as to be of little economic importance; also the continuing improvement in the technique of long-distance transmission is reflected in proposed transmission lines. The total of installed capacity of water-power plants in Canada is now listed at 14,304,230 hp which represents only 22 per cent of known resources. New plants and extensions which are scheduled for operation in 1953 total 860,000 hp, while other developments which are under preliminary construction, or are definitely planned for later years, exceed 2,000,000 hp.

In addition to water-power development, a number of thermal units of large capacity were brought into operation and others are under construction. Although the production of electric energy to meet Canada's expanding industrial and domestic consumption continues to be largely from hydraulic sources, thermal power capacity is also increasing and becoming a more important factor in the field of power production. Supplemented by the output of new hydraulic and steam plants, total production of electric power was at a rate of approximately eight per cent above 1951. In the country as a whole, power-production facilities were sufficient to meet the present demand but little reserve capacity was available.

In the field of power distribution, construction was also very active. New main transmission lines were completed or were under construction in many sections of the country, new transformer and substations were built, and secondary lines were extended. Good progress in rural electrification was achieved, particularly in Ontario, Quebec, and Manitoba.

Plastic Piping

PLASTICS, used either as coatings for other pipe, or as pipe itself, are providing a promising new market, according to the *Industrial Bulletin* of Arthur D. Little, Inc., December, 1952. Plastic piping has found many applications where corrosion resistance, flexibility, or lightweight are desired, the article notes. While substitutes for metal pipe and fittings are not new, their use has increased tremendously since World War II, and development of new types in standard sizes indicates that increasing use will be made of plastics. Plastic pipe consumed about 5 million lb of resin in 1951, but manufacturers predict that, in another ten years, production of such piping will reach 75 million lb per year. This still will be only a small portion of the total piping used, however; almost 7 million tons of steel pipe and 1.5 million tons of cast-iron pipe were used in 1949.

Phenol-formaldehyde resins are now sprayed on the inside of concrete, glass, or metal pipe for corrosion resistance. After baking at 400 F, the resins set to a hard finish, and are especially useful in piping for chemical plants where resistance to a wide variety of solutions is desired, or where contamination of the finished product is to be avoided. Such pipe will carry sulphuric acid of 60 per cent concentration at temperatures up to 225 F, and some films will withstand 400 F.

Vinyl-vinylidene chloride polymers are also used as pipe liners, and provide good corrosion resistance at temperatures between —40 and 194 F. This combination of metal and plastic has a high mechanical strength. The polymers alone have been used for flexible tubing to carry corrosive liquids and gases, and can be used for electrical conduits. When used alone, however, they are quite brittle and subject to fracture at temperatures below freezing. Gas companies have used short lengths as couplings between large distribution mains and small

feeder lines into homes. This type of pipe is one of the most expensive of the plastics, costing $2.49 per ft for 2-in. pipe.

Another plastic used as a liner is the furan type which is semithermosetting and semithermoplastic. It can be applied at room temperature by brush or spray, and is especially useful for carrying crude oil, gases, and refined oil products, since it resists the deposit of paraffins and is impermeable to water. In one installation, where conventional pipe carrying "sour" crude oil had lasted for six months, furan-lined pipe has been satisfactory for 21 months, and is expected to last for three more years. It is also used in coal mines, where the average life of untreated steel pipe may be only three to six months.

The *Bulletin* points out that although several types of plastic have proved satisfactory when used alone for pipe or tubing, best results are achieved when the plastic is chosen to meet the conditions of the specific installation; there is no all-purpose plastic. Cellulose acetate butyrate pipe is widely used in oil fields, since it is especially resistant to salt water or corrosive conditions in the soil, and prevents accumulation of paraffins, but it also finds several industrial applications outside the oil fields. Its relatively low cost, 81 cents a ft for 2-in. pipe, is also an attractive feature, when compared with stainless steel at $4.32, although it costs twice as much as galvanized iron. Polyethylene tubing and piping, which have the advantages of flexibility, lightweight, and ease of coupling, are ideal for carrying water on farms and ranches.

In mining operations, the article reveals, polyethylene pipe is used for water and for the water suspension of tailings. In one coal mine, untreated steel pipe, at 32 cents a ft, lasted only eight hours, but polyethylene pipe, at 66 cents a ft, is still in use after $2\frac{1}{2}$ years' service. The material is also used in underwater conduits for electric wires, and as telephone conduit. Important here is the ease of joining pipe sections—three men can install 500 ft of 4-in. pipe in 14 min. Since polyethylene softens appreciably at 110 F, it is not suitable for applications such as food processing, where steam sterilization is necessary. One of the newest applications, however, is for radiant-heating systems, where the temperature rarely exceeds 100 F and where, in any case, the pipe is supported by concrete.

Pipe made from styrene alone or combined with other materials, such as synthetic rubber or acrylonitrile, is especially suitable for carrying corrosive chemicals, particularly those containing chlorine. Such pipe has excellent resistance to acid and alkaline conditions in the soil, and is used for carrying water and waste on farms. One authority believes that piping promises to be one of the major fields of application for styrene plastics. The styrene-acrylonitrile combination is particularly useful for carrying petroleum and its products, and the high impact strength of the plastic makes it suitable for applications where it is subjected to vibration or rough handling.

Unplasticized polyvinyl chloride is extruded in standard pipe and tubing sizes. It has been widely used in Europe since the early part of World War II, and is an excellent replacement for copper or steel in some applications. Such pipe has unusually high resistance to acids, alkalies, and many solvents, has high impact strength, and is only one fourth as heavy as steel.

Body Armor

SHRAP jackets, for use by the U. S. Marine Corps as body armor, are being produced in quantity at the Westinghouse subsidiary, Plywoods-Plastics Corporation, Hampton, S. C.

In revealing that Westinghouse is making armoring material for the Marine Corps, the company reports that the shrap jackets get their lifesaving properties from three things—the way they are made, and their two basic ingredients, glass cloth and a synthetic resin. This combination enables the material, known as Doron, to actually stop deadly mortar and grenade fragments and similar low-velocity missiles.

When a fragment or a small-caliber bullet strikes the material, the layers of impregnated glass cloth separate as the missile attempts to smash its way through. This delamination actually sets up a cushioning effect that instantly reduces the velocity of the fragment to practically zero.

Doron, however, has been in post World War II volume production for only about two years but it has already won the confidence and gratitude of the thousands of American soldiers and Marines who wear it for protection in the front lines.

Reports indicate that the armor has been 90 to 95 per cent successful in preventing serious wounds of the torso. However, the Navy Bureau of Medicine and Surgery, which worked with Westinghouse in the development of Doron during the latter part of World War II, said full statistics on the real effectiveness of the armor will not be available until a survey now under way in Korea is completed.

Early versions of the armored vests consisted of flat Doron plates. Some of the flat material was used in utility jackets worn by Marines in mopping-up operations at Okinawa during the war in the Pacific. However, tests proved that the flat plates afforded less mobility. As a result, Doron is now curved so that it fits the contour of the body. The plates themselves, $\frac{1}{8}$ in. thick and $5\frac{1}{4}$ in. sq, are sewn into the pockets of heavy nylon vests. About 20 plates go into each vest and overlap each other like fish scales.

Doron is made by applying heat and pressure to layers of resin-impregnated glass cloth. While the exact details of manufacture are withheld for security reasons, it can be revealed that the layers are not pressed together tightly. If they were, the plates would lose some of their effectiveness.

Liquid-Cooled Generator

A LARGE generator with liquid-cooled conductors, said to be the first in the history of the electrical industry, will be manufactured by the General Electric Company, according to Glenn B. Warren, Fellow ASME, vice-president of the Company and general manager of the Turbine Division.

The new method of circulating a liquid through hollow conductors will be used in the stator of a turbine-generator set for the new Eastlake power plant of the Cleveland Electric Illuminating Company.

The unit, consisting of a tandem-compound turbine rated at 208,000 kw and a generator rated at 260,000 kva, will be one of the largest in the world. This generator, alone, will be capable of supplying the home electric needs of 600,000 people.

Mr. Warren said that this type of liquid cooling makes possible a significant increase in capability of generators without increasing physical dimensions of the units. The higher capability results from more efficient removal of heat produced during the generation of electricity.

The present method of cooling large generators is to circulate hydrogen gas through passages in the magnetic portions of the rotor and stator. Developed by G-E, this method is highly efficient for units up to approximately 230,000 kva capability at 3600 rpm.

The liquid-cooling method makes possible the design and manufacture of generator armatures having much higher capability than present units.

Other technical features of the Cleveland machine include direct cooling of the rotating field winding with hydrogen, a new and improved grain-oriented strip steel in the magnetic portion of the armature, and an improved type of insulation.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Heavy-Press Program

THE following papers compose a symposium on heavy presses for light-metal forging and extrusions. The group price for this symposium is $1.25 to ASME members and $2.50 to nonmembers.

Requirements for Large, Light-Metal Forgings and Extrusions in the Aircraft Industry, by George W. Papen, Lockheed Aircraft Corp., Burbank, Calif. 1952 ASME Annual Meeting paper No. **52—A-75** (mimeographed; to be published in Trans. ASME).

THIS paper discusses aircraft-industry requirements for large forgings and extrusions and supports these requirements by analyzing the effect of the trend in performance on aircraft structure, function, and production. The paper confirms that large integral structural components satisfy these trends better than a continuation of conventional "bits and pieces" structure. It further concludes that large forgings and extrusions are the most economical methods to produce integral-type structures.

In addition, detail requirements of large forgings and extrusions relative to physical properties, tolerances, and refinements are presented.

Statistical studies are presented to indicate the high potential use of large forgings and extrusions.

The trend in aircraft performance, it is pointed out, will result in a tremendous use for large forgings and extrusions, because they should be the most economical method of (1) meeting the space limitations set up in thin wings with high structural loads, (2) providing minimum weight by eliminating bits and pieces, (3) improving sealing for pressurization and fuel by eliminating sources of leakage, (4) improving aerodynamic smoothness, and (5) reducing man-hours required to fabricate and assemble aircraft.

The final answer as to whether or not large forgings and extrusions will be used is the cost in national effort which must be expended to obtain them as finished parts in an airplane, successfully accomplishing its mission. This necessitates that the cost of the forging or extrusion, plus any subsequent operations on the part of the airframe builder to make an acceptable part, requires a smaller expenditure of national effort than any other means of accomplishing the same result.

Only the combined co-operative efforts of the entire forging and extrusion industry from press designers through ingot producers through forging and extrusion producers, to and through the airframe manufacturers can accomplish all the promising gains to be had through the use of large forgings and extrusions.

The Design and Construction of Large Forging and Extrusion Presses for Light Metals, by M. D. Stone, Mem. ASME, United Engineering and Foundry Company, Pittsburgh, Pa. 1952 ASME Annual Meeting paper No. **52—A-76** (mimeographed; to be published in Trans. ASME).

THIS paper points out various design possibilities and trends, with more particular reference to the 35,000-ton vertical die-forging presses and the 20,000-ton horizontal extrusion press that the author's company is currently designing and constructing. Some reference is made to the smaller presses, notably the 8000-ton cast-type die-forging press, the 12,000-ton Lombard extrusion press, and to the Schloemann 13,200-ton extrusion press—as well as other press designs, in general.

There are some significant differences between the more usual open forging press and the die-forging press, the paper states. Die-forging presses, because of the high specific pressures required to properly fill the dies, especially where light thin-walled sections are involved, are considerably greater in tonnage capacity relative to entablature area. Open forging presses, especially for steel, and for other metals as well, must include the possibility of rapid stroking and accurate position control. These are of no concern in a die-forging press, velocity control during stroking being the particular requirement and forte of the latter. Another characteristic difference is their daylight requirements, which is the clear distance between bolsters. A 14,000-ton open-forging press has a maximum daylight of 24 ft, whereas the current 35,000-ton die-forging presses will have a daylight of 15 ft maximum.

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As to speed of operation, whereas the earlier die-forging presses were slow, having idling speeds of 2 in. per sec and pressing speeds of 1 in. per sec, the newer presses will reach open forging-press speeds of 10 in. per sec idling—and $2^1/_2$ in. per sec under full pressure. Requirements of planishing, at up to 50 strokes per min for large open-forging presses, do not have their counterpart in the die-forging press, cycle operations at faster than 1 per min being rare.

Die-forging-press construction, even for the larger sizes, can take on various forms. Over the years the use of forged columns has demonstrated their abundant advantages.

The 35,000-ton press—with possibilities of $^1/_4$, $^1/_2$, $^3/_4$, and full-pressure operation, without resorting to the extra complication of intensifiers—has eight cylinders and eight columns, essentially comprising four two-column press units, as far as the top entablature is concerned. This permits full proportional stressing of all columns—the units being free to stretch vertically independently of one another, yet keyed and bolted against lateral movements.

The matter of press maintenance must be properly recognized in the initial design of these large pieces of machinery, according to the paper. Of first importance is the possibility of maintaining and changing cylinder packing. This is accomplished by providing excess crosshead stroke so that the entire crosshead may be lowered well below the nominal low position, to permit the internal packings to be exposed for servicing.

Dominating considerations throughout the design of large presses are the maximum weight and dimensions that may be cast, machined, and transported. These large 35,000-ton presses will have several castings weighing up to 450,000 lb and yet of such dimensions that they may be shipped.

Another important consideration is permissible eccentricity of forging. Too many designers in the past have neglected this aspect of press design and have discovered that the so-called secondary stresses set up by eccentric forging may easily exceed the primary stresses due to central forging.

Metallurgy and Production of Suitable Aluminum-Alloy Ingots for Large Forgings and Extrusions, by T. L. Fritzen, Reynolds Metals Company, Richmond, Va. 1952 ASME Annual Meeting paper No. **52—A-77** (mimeographed; to be published in Trans. ASME).

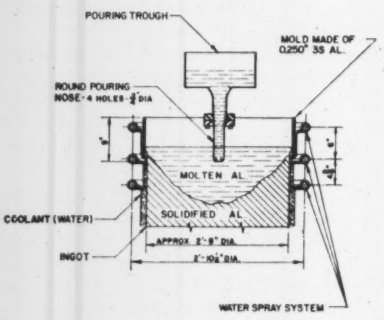
USE of larger and more complex aluminum-alloy structural members in the aircraft of tomorrow depends, initially, upon larger aluminum-alloy cast ingots suitable for upsetting, rolling, extruding, or forging.

This paper presents a discussion on the metallurgical factors and the mechanical features involved in the casting and production of large aluminum-alloy ingots suitable for extrusion presses up to 25,000 tons in capacity, and for forging presses up to 50,000 tons capacity. Sizes of aluminum-alloy ingots needed for the U. S. Air Force large press program are estimated and compared to the size of aluminum-alloy ingots cast in current production. Results obtained in the experimental casting of aluminum-alloy ingots larger than those cast now in production are described.

In this paper the strong aluminum-alloy ingots which will be used for making structural components of aircraft are discussed. These alloys, principally 14S, 24S, and 75S, derive strength through heat-treatment due to the limited solid solubility of hardening alloying elements.

The direct-chill process is selected for development of the casting of large ingot. Quality required, metallurgical factors involved, equipment used, and casting variables are discussed.

The principal problem in D-C casting consists of determining means to minimize the temperature differential, and resultant strains, in the ingot during casting in order to avoid cracks, and to obtain an ingot free from harmful porosity. There are probably several combinations of D-C casting variables that will produce satisfactory ingot. There are several modifications of D-C equipment that have been considered but not tried due to the lack of high-cost facilities needed. A requisite for casting the large ingot needed is clean molten metal containing a minimum of gas. The author agrees with European contention that the use of induction furnaces for melting and electric furnaces for holding offer the best opportunity of obtaining clean, gas-free aluminum alloys.



SKETCH OF D-C CASTING EQUIPMENT FOR PRODUCTION OF 32-IN-DIAM 14S ALUMINUM-ALLOY INGOT

The paper concludes that the D-C casting of 14S, 24S, and 75S aluminum-alloy ingots of rectangular cross section up to 12,000 lb in weight, and square and round ingot up to 8000 lb will be developed to produce suitable, metallurgically sound, stock for the U. S. Air Force large press program.

Large Forging-Press Operations and Production Problems, by G. W. Motherwell, Mem. ASME, J. R. Douslin, and A. L. Rustay, Wyman-Gordon Co., Worcester, Mass. 1952 ASME Annual Meeting paper No. **52—A-78** (mimeographed; to be published in Trans. ASME).

EXAMPLES of forging-design problems and progress are shown and discussed in this paper illustrating recent advancements in the production of forgings with thin webs, smaller fillet and corner radii, and closer tolerances.

Advancements in manufacturing techniques are described, including new processing methods and equipment.

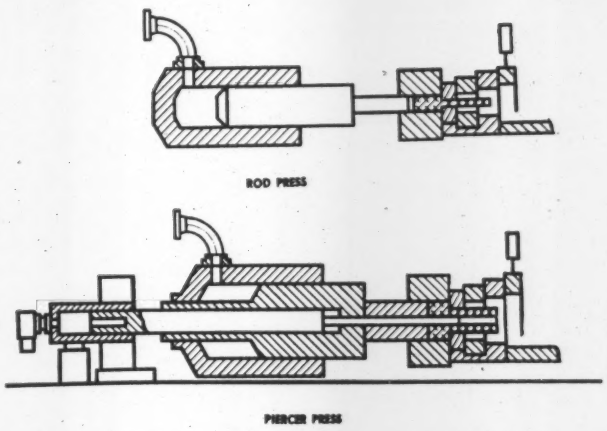
Factors affecting procurement time and cost are also discussed.

The paper points out that after more than five years of experience in heavy-press operation for the production of aircraft forgings, there seem to be several general factors which contribute to the problems of manufacture, namely, time, quality, and cost. Circumstances and engineering judgment dictate the relative importance of each. These three factors may be considered from two viewpoints—those which must be controlled and fixed in the shop, and those that depend for solution on adequate assistance from the outside.

Large Extrusion-Press Operation and Production Problems, by T. F. McCormick, Aluminum Company of America, Pittsburgh, Pa. 1952 ASME Annual Meeting paper No. **52—A-79** (mimeographed; to be published in Trans. ASME).

EXTRUSION is a comparatively new manufacturing method largely developed within the present century for the fabrication of wrought-metal shapes and tubes, the paper states. In a relatively short period, extrusion has become established as one of the most important methods for the manufacture of widely used shapes, particularly in the light-metal industry.

The largest extrusion press in operation in this country today has a rated capacity of 5500 tons. The size most commonly used for producing the types of extrusions used in aircraft is the 2500-ton press. There is a distinct break



TYPES OF EXTRUSION PRESSES USED FOR PRODUCING ALUMINUM-ALLOY EXTRUSIONS

between the ingot sizes used and the extrusions produced with 2500 and 4000-ton presses. On this basis a press with a rated capacity of 4000 tons or more can be considered a large extrusion press.

With the limitation of considering only light-metal extrusions used for modern aircraft, aluminum alloys are discussed almost exclusively. Magnesium-alloy shapes are in the same category, but the relative tonnage produced on large presses is small at the present time.

Giant presses now under construction or planned in this country will enlarge by several fold the size of light-metal shapes and tubes that may be extruded. Operation of the new presses will present many production problems, both predicted and unpredicted, but at the same time will permit the extrusion of large or intricate shapes which lead to economy and versatility in aircraft construction. A review of operating techniques and problems associated with present large extrusion presses points out some of the expected problems and emphasizes the increased scope of the extrusion process to provide metal shapes designed for the utmost usefulness.

Air-Cargo Transportation

The Civil Aeronautics Administration's Interest in Air-Cargo Terminal Requirements, by Philip A. Hahn, Civil Aeronautics Administration, U. S. Department of Commerce, Washington, D. C. 1952 ASME Annual Meeting paper No. **52—A-158** (mimeographed).

CARGO-HANDLING equipment and techniques have a profound effect on the nature and extent of cargo facilities needed at an airport. The big problem lies in the gap between the cargo building and plane, according to this paper.

The paper notes from an engineering survey of a typical air-freight operation that 85 per cent of the in-transit time for goods shipped from New York to Detroit represented ground handling and only 15 per cent time in the air. In transporting air cargo between New York and Los Angeles, the paper noted, 67 per cent of the total time was spent on the ground.

The paper cites data from a recently completed study by the CAA "Domestic Air Cargo Forecast," which estimated "that by 1955 enplaned air freight would approximate 450,000 tons annually and that by 1960 the volume would reach 850,000 tons annually.

All phases of airport activities related to air freight must be scrutinized toward a reduction of the time necessary to perform the operations as well as the costs thereof.

Air-Cargo Terminal Requirements—The Airport Operator's Viewpoint, by Thomas M. Sullivan, The Port of New York Authority, New York, N. Y. 1952 ASME Annual Meeting paper No. **52—A-165** (mimeographed).

IT is important that the airport operator make available today a complete and efficient air-cargo terminal, according to this paper. A building must be furnished which can grow with the industry and not be rendered obsolete in either equipment or operating procedures.

This paper describes an air-cargo terminal to handle its cargo-transfer operation efficiently with the least use of time and manpower. This terminal would have a continuous truck dock on the road side of the terminal building, and shipments would be unloaded on slat conveyers flush with the floor or on an overhead monorail. Weighing and billing would be accomplished at the end of the conveyer. Shipments would then be assembled on pallets and transferred to the consolidation area by fork trucks. Centrally located within the consolidation area will be cold rooms, warm rooms, and rooms for the storage of valuables. Aircraft parked on the apron adjacent to the building will be connected by a bridge or dock connecting the terminal floor with the aircraft-cargo-compartment floor.

The paper sums up the airport operator's viewpoint on an air-cargo terminal as a terminal built to serve a healthy industry—a terminal which can grow with the industry—and a terminal that will be financially self-sufficient.

The Air-Cargo Terminal, by H. O. Olson, Douglas Aircraft Company, Inc., Santa Monica, Calif. 1952 ASME Annual Meeting paper No. **52—A-116** (mimeographed).

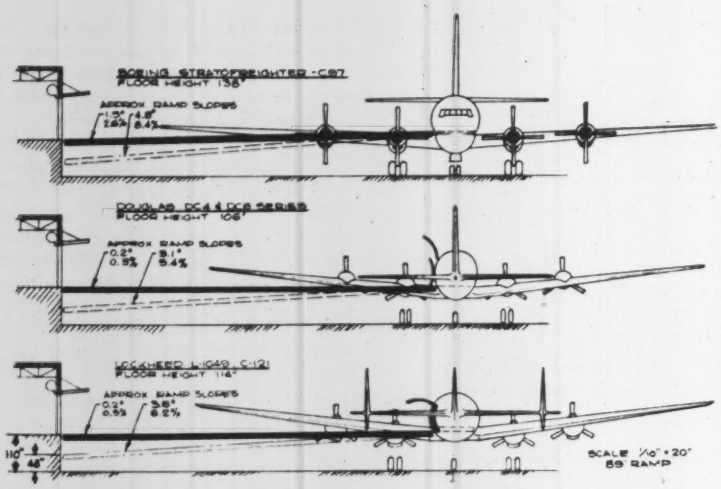
IN this paper the problems confronting the air-cargo-transportation industry with respect to the ground handling and loading of cargo are discussed from an aircraft manufacturer's point of view. Specifically, the paper presents the development of a terminal facility and describes the problems involved in the loading of all-cargo airplanes.

Requirements for an air-cargo terminal, the paper states, are basically those of providing a means of efficient material handling. The problem starts at the point of delivery by surface transportation, follows through weighing, manifesting, load consolidation, and the ultimate movement to a position in the airplane.

The problem of movement beyond the point of load consolidation to an ultimate position in the airplane is unique to air transportation, because an airplane cannot be conveniently positioned to a loading dock so that its deck is at a common level with the terminal.

The paper predicts the introduction of air-cargo loading docks as the key to reducing ground-handling costs. Loading docks will be projected out to the airplane so that the cargo can be moved with a minimum of handling operations.

According to the paper, the air-cargo terminal will consist of the terminal building and the required loading docks, supported by specific material-handling devices for the most efficient movement of cargo. With such accommodations, the



AIR-FREIGHT TERMINAL DOCK HEIGHT STUDY

on/off loading of cargo aircraft should be at the approximate rate of 1000 lb per min.

Air-Cargo Terminal Requirements, by F. E. Hembree, Flying Tiger Line, Inc., Burbank, Calif. 1952 ASME Annual Meeting paper No. **52—A-134** (mimeographed).

IN air-cargo terminal planning and construction, the volume, potential volume, and type of aircraft to be accommodated must be taken into account. The keynote would be a terminal designed with simplicity, allowing for direct work-flow with the minimum of re-handling.

The paper lists the following basic elements as necessary for future terminal requirements: (*a*) Terminal must be planned to effect the least amount of handling in a direct work-flow pattern and lend itself to good housekeeping; (*b*) provide an adequate amount of preplanned warehouse area; (*c*) provide speedy access to freight, in order to reduce the ground time required to handle the freight; (*d*) cooling facilities to provide the storage space for this type of commodity; (*e*) provide well-planned aircraft parking area to accommodate the number of planes required at that terminal; (*f*) simplicity of structure to preclude impeding projections; (*g*) incorporate devices and features found to be practical, for example, the lift bedded truck and the turntable; (*h*) possible use of double-decked storage bins—accessible by fork-lift for storage of excess station material; and (*i*) installation of ground-level dock to facilitate off-loading of trucks.

Air-Cargo Terminal Requirements, Combination Passenger-Air Freighter Operator's Viewpoint, by F. W. Jones, American Airlines Inc., Flushing, N. Y. 1952 ASME Annual Meeting paper No. **52—A-133** (mimeographed).

THIS paper sums up the requirements for a freight terminal for operators who operate both passenger and all-cargo equipment as follows: To be in one building, as close to passenger terminal and hangar areas as possible, should have floor at ground level, should be rectangular in shape, not less than 50 ft wide, and should have ceiling at about 18 ft. There should be adequate aircraft parking area, good lighting and ventilation, and good office areas. Better methods of loading and unloading all-cargo aircraft should be developed. As a further requirement, it is believed that ways must be found to mechanize the processing of freight. Too much time, the paper notes, is consumed in counting, weighing, rating, billing, and lot labeling.

The layout of the cargo flow through a terminal will vary with individual carriers, the type of operation, and the type of cargo predominantly carried. It will also vary with the volume of cargo and individual company requirements—such as paper work and security.

Air Cargo Unlimited, by Ian H. Grabowsky, Australian National Airways Pty. Ltd., and Air Beef Pty., Ltd., Melbourne, Australia. 1952 ASME Annual Meeting paper No. **52—A-119** (mimeographed).

DEVELOPMENTS in air cargo in Australia are discussed in this paper with special reference to the unique advantage of air transport in isolated areas where there are no surface transport facilities.

The paper recommends an aircraft with a standard motive-power unit and availability of interchangeable cargo compartments—semitrailers of the air—similar to the detachable trailer trucks used by the trucking industry. Economies achieved by this semitrailer of the air, according to the paper, would include reduction in handling of cargo, reduction of time on the ground for loading and unloading, simplicity in cargo handling, among other benefits.

The paper also reports on the air-beef scheme, by which beef carcasses from slaughterhouses in remote inland areas of northwestern Australia are flown by air freighters to railheads on seaports. Two such decentralized units already are in operation, accomplishing significant savings to stockmen on the island continent both in time consumed in walking cattle to the slaughterhouses—the earlier 51-day trip is now cut to 3 days 2½ hr—and in the poundage lost in moving cattle from the range over arid country.

According to the paper, a time may come when the beef handled will rise from today's 2000 tons per annum in four months to 360,000 tons per annum over eight to nine months of the year.

Air-Cargo Development in Europe, by D. Sj. de Boer, KLM Royal Dutch Airlines, The Hague, Holland. 1952 ASME Annual Meeting paper No. **52—A-118** (mimeographed).

EXCHANGE of ideas and facts on air-cargo operation among European airlines would be beneficial for the industry as a whole and of advantage to each airline individually, according to this paper. Air cargo carried by European airlines is showing a marked increase over past years. Small parcel traffic constituting at present the majority of consignments gives a wrong impression about cost of actual cargo operation. Present passenger planes do not allow cargo traffic in the real sense of the word, load capacity and accessibility of holds being inadequate.

In Europe and America the desire for a short-haul cargo plane is the same. In short-haul European traffic, low-cost cargo operation is essential, the realization of which mainly is a technical engineering problem. Technical handling of cargo and suitable bonded warehouses at the airports are essential for the promotion of the cargo traffic.

Air cargo in Europe is progressing, it is pointed out, though it still forms

approximately one fifth of the total revenue tons per km sales of the European companies. There is need for more cargo capacity. Though speed has its own selling price, and additional advantages obtained from shipping by air are attractive to the shipping public, these air-cargo characteristics require in local European cargo markets highly efficient and developed surface transport, which places rate competition in the focusing point.

The Development of Transatlantic Air Freight in Relation to Air Logistics, by Carl D. Brell, Seaboard and Western Airlines, Inc., New York, N. Y. 1952 ASME Annual Meeting paper No. **52—A-122** (mimeographed).

THIS paper discusses the growth of transatlantic air freight, and the roles played by commercial air carriers in the Berlin and Pacific airlifts. These military-civilian air operations resulted in the organization of the civil air reserve fleet. This provides for the immediate availability of a portion of the U. S. commercial air fleet for logistical support of the military in the event of further national emergency.

Forty per cent of the lift to be supplied from civilian air fleets, it was noted, would be derived from the use of DC-4s, the "workhorses of the air" first put into service about ten years ago.

The paper points out that to develop transatlantic air freight to its ultimate and to afford the greatest air logistical value to our national defense, larger airplanes are necessary which are economical enough to provide shippers with a tariff structure sufficiently low to generate a constant flow of billions of pounds, rather than millions.

The Fleet Logistic Air Wing, by J. I. Taylor, U. S. Naval Air Station, Patuxent River, Md. 1952 ASME Annual Meeting paper No. **52—A-115** (mimeographed).

IN this paper the organization and function of the Navy's Fleet Logistic Air Wing, which provides air transportation for the sea service, is described. Particular reference is made to factors that make operations unique and to the methods developed to take care of these problems.

The work of the Fleet Logistic Air Wing, the paper states, is constantly increasing, with average daily utilization of present aircraft running about one third above their "calculated capability." The Navy is increasing its airlift by changing to higher-capacity equipment, replacing DC-3s with Super DC-3s and DC-4s, while the long-haul routes of present DC-4s will be taken over by new Lockheed Super Constellations.

The paper concludes by stating that today air freight is being carried in aircraft designed for passengers. The need is for aircraft designed specifically for low-cost cargo operations. With this type of equipment air-cargo rates for medium and long-haul operations should be directly competitive with all other forms of transportation, with the possible exception of water freight.

Air Transportability With "Troop Carrier," by Maj. Gen. R. W. Douglass, Jr., Eighteenth Air Force, Donaldson Air Force Base, Greenville, S. C. 1952 ASME Annual Meeting paper No. **52—A-117** (mimeographed).

WITHIN the Department of the Air Force, two distinct organizations perform the air-transport mission—the Military Air Transport Service and the Troop Carrier Forces. This paper discusses the Troop Carrier Forces which operate only within a theater of operation.

The Troop Carrier Forces provide air transportation for the movement of troops, supplies, and equipment into prepared or unprepared landing areas, either by parachute or air, landing in a theater of operations and supply such forces continuously or until they are withdrawn. They also provide routine air transportation within the theater of operations, and provide for the evacuation of casualties, troops, and materiel.

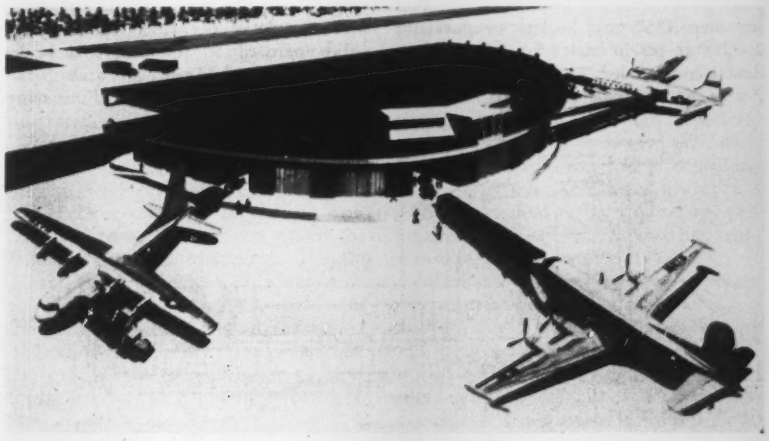
Air transportation, according to the paper, is essential to the time element in modern warfare. For this purpose MATS and troop-carrier operations must be capable of supporting each other, with MATS furnishing air transport between theaters and troop-carrier forces taking over within the theater. For this job, it was disclosed, several kinds of aircraft are operated, depending on the mission. For assault operations C-122s, C-123s, and two types of helicopters, H-19s and H-21s are used. Medium equipment includes C-46s, C-82s, and C-119s, while the heavy-duty planes are big C-124 Globemasters. Pointing out that these are primarily transport-type aircraft and lack adequate armament or protective armor, the paper emphasizes that troop-carrier operations still require air supremacy in drop zones and adjacent areas.

Air Transportability With Mats, by Lt. Gen. Joseph Smith, USAF, Military Air Transport Service, Andrews Air Force Base, Washington, D. C. 1952 ASME Annual Meeting paper No. **52—A-154** (mimeographed).

THE Military Air Transport Service is discussed in this paper with reference to developments in cargo handling, the Air Force C-130, and jet air transportation. MATS is an organization which flies 10,000 tons of cargo and passengers each month around the world.

Key factors in MATS traffic plans for gaining the maximum from the larger, faster transports of the future are modern terminals designed and built to provide fast, easy handling of air cargo and rapid loading of aircraft; streamlined procedures to minimize handling operations; and absolute reduction in tare weight, so that the load carried is truly "pay load."

In discussing the outlook for the Lockheed Turbo-Prop C-130 now being developed for the Air Force, the paper reveals that it has the advantages of a box-car-type cargo compartment con-



AIR TERMINAL AS PROPOSED BY MATS

figuration, tail-end straight-in loading characteristics, and the safety performance advantages of four-engine aircraft.

Concerning jet air transportation, the paper states that MATS wants an airplane much bigger and faster than any jet transports now flying. It would carry 15 tons of pay load 2200 nautical miles at a cruising speed of 550 knots. The paper reveals that three of the nation's major aircraft manufacturers are now studying jet transportation for the Air Force.

Air Transportability Capabilities of the Commercial Air-Freight Carrier, by Thomas L. Grace, Slick Airways, Inc., Burbank, Calif. 1952 ASME Annual Meeting paper No. **52—A-164** (mimeographed).

THE operations and future outlook for air-freight transportation in the commercial field are discussed in this paper. Economic advantages of air freight are given as reduction in tare weight which saves money by the reduction in the gross weight of the packaged article, speed in delivering perishable articles, and reduction in damage and loss from the vibration and shock which articles are exposed to in surface transportation.

According to the paper, commercial air freight has had a rapid growth since the war, increasing from 40 million ton-miles in 1946 to an estimated 250 million ton-miles in 1952. Today's air-freight fleet, consisting primarily of wartime C-46s and C-54s, totals 93 aircraft on eight air-freight lines with a cargo capacity of 750 tons per eight-hour day. New aircraft now on order will increase this capacity to 1000 tons per day by the end of 1954.

Commercial air-freight operators also have value as a stand-by reserve for military use in emergencies, such as Berlin and Korean airlifts. For this reason, the paper states, commercial requirements should be kept in mind by military authorities in the design of new cargo aircraft. To help bring the needs of the air-freight industry before the proper authorities, the paper suggests the creation of an Airfreight Advisory Committee in the Air Force or military agencies generally, patterned after the Industry Advisory Committee of the Department of Commerce.

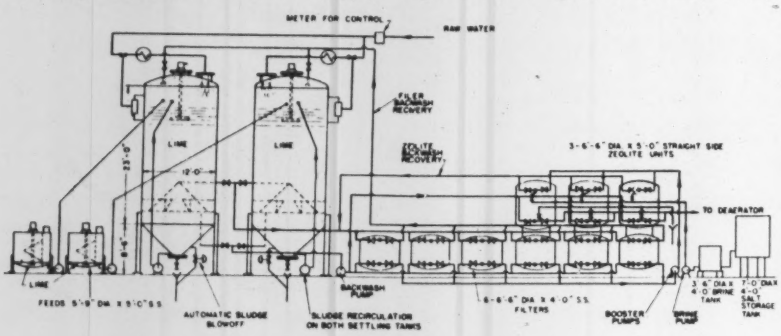
Boiler Feedwater Studies

Conversion of a Two-Stage Hot-Process Water Softener From Hot-Lime Soda Phosphate to Hot-Lime Zeolite, by G. H. Gowdy, New England Gas and Electric System, Cambridge, Mass., and S. B. Applebaum, Mem. ASME, Cochrane Corporation, Philadelphia, Pa. 1952 ASME Annual Meeting paper No. **52—A-96** (mimeographed).

IN 1949 a 16,000 gph two-stage hot-lime-soda hot-phosphate softener was installed in the Kendall Square Station of the Cambridge Electric Light Company to treat up to 30 per cent makeup for two 1350-psig boilers evaporating 200,000 lb per hr each. In 1951 makeup demands exceeded 20,000 gph at times. A storage tank was considered to supply the peak demands. But conversion to hot-lime zeolite proved more economical.

The second-stage phosphate settling tank now operates in parallel with the first-stage tank providing 32,000 gph settling capacity. Three more filters were added and three new hot-zeolite units were mounted over the filters to save space.

Improved results obtained were: Alkalinity and CO_2 in steam cut in half, phosphate deposits in economizer and heaters eliminated, operating cost reduced from $7.86 to $4.30 per 1,000,000 lb, total solids reduced 16 per cent and boiler blowoff reduced 25 per cent, and operating control simplified by eliminating soda ash and other chemicals adding phosphate direct to boilers.



FLOW DIAGRAM FOR HOT-LIME ZEOLITE PLANT

In conclusion, the paper stated that the hot-lime zeolite plant at the Cambridge Electric Light Company's station has given an improved quality of treated water at a considerable saving in operating cost compared to the former hot-lime-soda hot-phosphate plant which it replaced.

The operating problems that have arisen in the tuning-up period which are described in this paper have been satisfactorily solved. The remedies found should be of value in the design and operation of similar equipment at other plants. The practicality of this hot-lime zeolite process, which received its first industrial application about two years ago, has been demonstrated and a widespread use of this process in new installations or by similar conversion of hot-lime-soda phosphate plants, especially when increased capacities are required, may be anticipated.

Experimental Studies of Boiler Tube-Metal Temperatures: Effect of Heat-Transfer Rate and Deposit Thickness, by C. Jacklin, National Aluminate Corporation, Chicago, Ill. 1952 ASME Annual Meeting paper No. **52—A-30** (mimeographed).

RESULTS of induction-heated experimental boiler studies of tube-metal temperatures are shown in this paper for heat-transfer rates from 140,000 to 300,000 Btu per sq ft per hr and for pressures from 250 to 2500 psi. Clean tube conditions and different kinds of deposits were also studied. The approximate relationship between metal thickness, heat-transfer rate, and temperature drop through the metal are shown in graphic form. Approximate relationship between scale thickness and temperature increase in the tube metal at a given heat-transfer rate and pressure is shown for four scales.

Some of the factors which affected the accuracy of the results are: eccentric position of the induction-heating coil, scalloped heat pattern caused by individual turns of the induction coil, distortion of the heat-flow pattern by the thermocouple hole, poor thermal contact between thermocouple and tube metal, conduction through the thermocouple wires, nonuniform distribution of steam bubbles and circulation pattern over the heated area of the tube, stray emf in the thermocouple from the high-frequency induction field, variation of heat-conductivity coefficient with temperature, both of the tube metal and the deposit, diverging heat pattern in the wall of the tube, and change in film coefficient

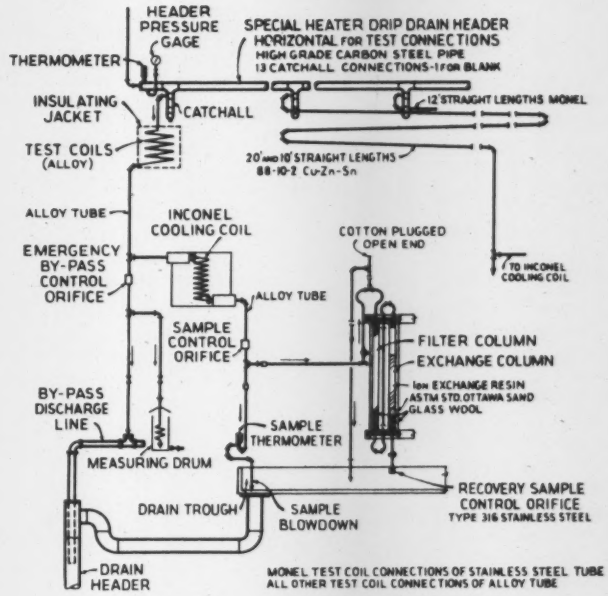
between metal-water and deposit-water interfaces due to changes in surface area and roughness.

In spite of the many variables present in this method of testing the results are in good agreement with the results of previous experimental work by other investigators, the paper states. However, the observation made by previous investigators that porous deposits have low heat conductivities and dense deposits have high heat conductivities does not appear to be confirmed by this investigation. The relative positions of the deposits investigated based on their heat-conductivity coefficients also coincides with generally accepted field experience.

Contamination of Condensate by Heat-Exchanger Tube Alloys, by J. D. Ristroph, Virginia Electric and Power Company, Richmond, Va., and E. B. Powell, Mem. ASME, Stone & Webster Engineering Corporation, Boston, Mass. 1952 ASME Annual Meeting paper No. **52—A-63** (mimeographed; to be published in Trans. ASME).

THE accumulation of foreign metal and metallic oxides on the internal heating surfaces of high-pressure boilers has become a source of growing concern to the steam-power industry in the United States. Especially over the past ten years with the advent of the 2000-psi and higher-pressure steam generators, such deposits have been found serious hazards. These deposits all retard heat transfer and so tend to high temperature in the tube walls, tending in turn to overheating, or corrosion, or both. Deposits of copper origin seem to have the further objectionable property of masking the evolution of hydrogen from the affected surface, which might otherwise give advance warning of the impending failure. Operating experience has pointed to corrosion and solution of metals of the steam condensate-feedwater part of the system, external to the boiler proper, as normally the major source of the boiler heating-surface metallic deposits in the so-called 100 per cent condensate-feedwater-type plant to which the present paper directly refers.

This paper presents results from condensate-contamination studies conducted at two steam-power stations to evaluate the influence of temperature of condensate, of differing dissolved gas content, and of cumulative service time upon the degree of metallic contamination to be expected in steam condensate of the general character described from flowing contact with tubing of 12 alloys commercially used in power-plant heat exchangers. The influence of cyclohexylamine on the rates of contamination is also indicated. The testing procedures are briefly described.



DIAGRAMMATIC ARRANGEMENT OF ALLOY TEST COILS AND METALLIC RECOVERY EQUIPMENT

Gas-Turbine Power

Effect of Rotary-Regenerator Performance on Gas-Turbine-Plant Performance, by David B. Harper and Warren M. Rohsenow, Jun. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1952 ASME Annual Meeting paper No. **52—A-149** (mimeographed; to be published in Trans. ASME).

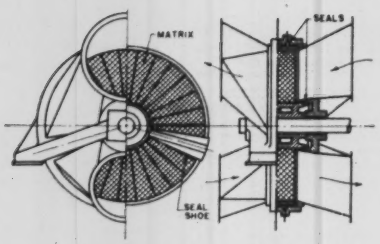
THE effect of leakage and pressure drop in a rotary regenerator on gas-turbine-plant performance is investigated in this paper. Effect of the regenerator dimensions—length, cross-section area, and rotative speed—on the regenerator and plant performance is illustrated.

The efficiency of a simple gas-turbine plant can be increased, the paper states, by using a regenerative cycle in which a heat exchanger is used to transfer heat from the hot turbine exhaust gas to the cooler compressor discharge air. In general, the type of heat exchanger considered for gas-turbine applications has embodied a stationary wall separating the hot and cold fluids. These have commonly taken the shell-and-tube geometry, arranged for either counterflow or cross-flow passes.

Principal advantage of the rotary regenerator is the possibility of designing a more compact unit than is possible with the conventional shell-and-tube or plane-fin stationary-surface type. Calculations show that as passage diameter is reduced to very fine dimensions, heat-exchanger volume, for a given effectiveness and pressure drop, can be reduced appreciably. The matrix of the rotary regenerator can be finely divided, without structural difficulty and the resulting matrix volume may be one tenth or less than the corresponding tube-bundle volume of a conventional heat exchanger. The sealing and ducting arrangements, and the like, especially for multidisk regenerators of larger capacities, would occupy a considerable volume but indications are that a regenerator could be built to occupy perhaps $1/3$ or $1/4$ of the volume of a conventional heat exchanger.

Inherent in the operation of a rotary regenerator is a leakage of some of the high-pressure air into the lower-pressure turbine exhaust-gas side.

Leakage will occur at the seals due to constructional difficulties and thermal distortion. As these seals are present on each side of the rotor, cold air will leak into the cooled gas stream and will not pass



ROTARY REGENERATOR

through the matrix; and heated air will leak into the hot gas stream and return through the exhaust side of the regenerator. In addition to seal leakage there is the positive displacement or "let-down" loss of compressed air trapped in the matrix compartments as they pass the seals into the gas side. The let-down loss will be proportional to matrix rpm, and to the pressure ratio across the regenerator. The seal leakage may be considered essentially independent of rotational speed but will depend on pressure ratio.

The Rotary Regenerative Air Preheater for Gas Turbines, by A. T. Bowden and W. Hryniszak, C. A. Parsons & Co., Ltd., Newcastle Upon Tyne, England. 1952 ASME Annual Meeting paper No. **52—A-74** (mimeographed; to be published in Trans. ASME).

DISCUSSION in this paper is confined to the rotary type of regenerative heat exchanger (Ljungström type), although several of the problems discussed could apply equally well to other types. The paper is concerned with a regenerator used as the air preheater in a simple open-cycle gas turbine. However, the conditions relating to working temperature, temperature and pressure gradients, and other factors are so severe that they may cover several other applications beyond the gas turbine.

Advantages of the regenerative-type heat exchanger are that small hydraulic diameters can be readily attained, and that when the normal counterflow arrangement is used the matrix is self-cleaning to some extent, particularly during that part of the operating cycle when high velocities and pressure differences are experienced. Against this must be taken the problem of providing an efficient seal between the air and gas flows.

In comparison, if flame-trap matrixes are employed in both, the recuperator can be designed to have hydraulic diameters of the same order as those in the regenerator. The matrix, however, is not self-cleaning, and thus continuous outside provision must be made to keep it in working order. This necessarily involves an equivalent power loss, but one which can justifiably be compared with the auxiliary power losses of the regenerator. The separation of the gas and air flows, however, must be made in the matrix itself, which complicates the problem of cheap and simple manufacture.

Residual Fuel-Oil Ash Corrosion, by B. O. Buckland, Mem. ASME, C. M. Gardiner, Mem. ASME, and D. G. Sanders, Jun. ASME, General Electric Company, Schenectady, N. Y. 1952 ASME Annual Meeting paper No. **52—A-161** (mimeographed).

THIS paper summarizes the tests made in the laboratory and the experience of operating gas turbines in the field relative to corrosion of the metallic parts in the gas path due to the slag-forming substances in residual fuel oils.

Some residual oils cause rapid deterioration in the gas-turbine first-stage nozzles and combustion-chamber liners due to corrosion. No such corrosion exists on natural-gas burning units. The nature of the ash in the oil rather than its amount is important in corrosion. No gas-turbine alloy is in sight at present, the use of which alone would result in a complete solution of the problem. The tests and experience indicate that by proper adjustment of the constituents of the ash and the choice of a suitable alloy, satisfactory operating life of the gas-turbine parts can be obtained. One such set of ash-constituent relationships is defined.

Work with the crucible tests and small-burner tests is continuing as is also the experience with the use of specification-type residual on the locomotives.

Residual oils, modified at the point of use by means of slurries and by means of mixing water solutions of additives to the oil, are beginning to be used on the New England gas turbines. It is expected, however, that this method of obtaining a noncorrosive residual will be an interim phase of the development only. It is hoped that eastern residual suppliers will soon be in a position to supply oil already suitably modified when delivered.

The Use of Residual Fuel Oils in Gas Turbines, by P. Draper, Shell Petroleum Company, Ltd., London, England. 1952 ASME Annual Meeting paper No. **52—A-127** (mimeographed).

THIS paper discusses the major difficulty experienced in Europe in connection with the combustion of heavy residual fuel oils in gas turbines, namely, ash deposition on the turbine blades.

It points out that such grades of fuel oils all form some sort of ash on combustion unless they are refined when they are raised to a higher price level. Thus, if this class of fuel is to be used, the gas turbine must be made capable of digesting it.

The paper continues with a theory, based on experimental work and confirmed by practical tests, concerning a method of reducing or eliminating this trouble by control of combustion conditions. It is not claimed as the only method but as one worth following up.

A review of the operation of gas-turbine units in Europe is also given.

ASME Transactions for February, 1953

THE February, 1953, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Gas-Turbine Progress Report—1952
- Gas Turbines in Our Century, by Claude Seippel
- Introduction, by R. Tom Sawyer. (52—F-1A)
- Materials, Cooling, and Fuels, by A. A. Hafer. (52—F-1B)
- Cycle Components, by P. F. Martinuzzi. (52—F-1C)
- Automotive, by F. L. Schwartz. (52—F-2)
- Railroad, by K. A. Browne, J. I. Yellott, and P. R. Broadley. (52—F-3)
- Marine, by W. A. Dolan, Jr., and A. A. Hafer. (52—F-4A)
- Merchant Vessels, by W. A. Dolan, Jr., and A. A. Hafer. (52—F-4B)
- Naval Vessels, by W. A. Dolan, Jr., and A. A. Hafer. (52—F-4C)
- Stationary Electric Generation, by Lee Schneitter. (52—F-5)
- Industrial, by L. N. Rowley, Jr., and B. G. A. Skrotzki. (52—F-6)
- Aviation, by I. H. Driggs and O. E. Lancaster. (52—F-7)

Local Heat-Transfer Coefficients on the Surface of an Elliptical Cylinder in a High-Speed Air Stream, by R. A. Seban and R. M. Drake. (52—SA-11)

Torsional Vibration Notes With Solutions for an Untuned Viscous Damper and Flexible Coupling With Nonlinear Elasticity, by F. P. Porter. (52—OGP-7)

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—II, by A. Charnes and E. Saibel. (52—SA-2)

The Shear-Angle Relationship in Metal Cutting, by M. C. Shaw, N. H. Cook, and I. Finnie. (52—SA-51)

Comparisons at Elevated Temperatures of Some Commercial Grades of Ferritic Cast Steels, by H. W. Wyatt, J. W. Bolton, and M. L. Steinbuch. (52—SA-53)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Engineering Aspects of Plywood

COMMENT BY DON BROUSE[1]

Because of his sustained interest and long experience in the field, the author of this paper on plywood[2] is uniquely qualified to tell the story of the plywood industry. He has drawn skillfully on that background to give us a paper that combines historical value with a challenge for further improvement.

He has listed the advantages of plywood over solid wood and emphasized directions in which additional research might lead to further expansion of the industry. In the list of current needs it seems that somewhat more emphasis might have been given to the reduction of waste. For example, Fig. 16 of the paper illustrates the high theoretical yield of veneer that can be obtained from a cylindrical bolt but unfortunately such high yields are seldom realized in commercial operations that must utilize the logs available.

Studies of yellow birch-veneer production[3] at commercial mills have shown that the average birch log yields about 47 per cent of its cubic volume in merchantable veneer and that an exceptional bolt is required if the yield is to reach 60 per cent. The studies showed further that some 3.7 per cent of the cubic volume was lost in trim-off waste, approximately 3.5 per cent in excess length of bolt, about 17 per cent in rounding, 12 per cent in clipping, and 18 per cent in cores. Converting the veneer into plywood involves an additional waste that may run as high as 50 per cent of the potentially usable veneer. Consequently, the yield of finished plywood expressed as a percentage of log volume may run as low as 20 to 25 per cent.

In the Douglas-fir plywood industry[4] larger logs are involved and the product permits a larger percentage of the veneer produced to be used in the panels. Consequently, the relative volume of waste is lower than in the hardwood-plywood industry. The yield in terms of plywood is said to be considered average if the square footage of $^3/_8$-in. plywood obtained equals 2 to $2^1/_2$ times the board-foot scale of the log. On the basis of a log with an average diameter of 40 in., this yield amounts to some 55 to 68 per cent of the cubic volume of the log.

If these plywood-yield figures are compared directly with lumber-yield figures, however, the results may be misleading. The finished plywood product is often of such size and quality that it can be used in the final application without further waste while lumber usually requires further surfacing and trimming before it appears in the finished article ready for the consumer.

While the manufacture of plywood may thus be a less wasteful method of converting logs into useful products than sawing into lumber, the waste remains larger than desirable. Consequently, it is suggested that the reduction of waste by improvement in manufacturing technique might well be included as a goal in the future developments of plywood.

COMMENT BY A. G. H. DIETZ[5]

The author draws upon the great wealth of experience which he has accumulated over the years in his widespread contacts with the plywood industry. Consequently, he speaks with considerable authority. His paper is largely a review and a report upon the present status of the plywood industry coupled with an interesting summary of its early history.

Comments respecting education in plywood development are pertinent. It is, of course, true that few, if any, universities have set up courses in plywood as such. This is true of engineering schools as well as of schools of forestry. Courses in wood utilization and in the properties of wood are quite numerous, and in these, plywood, of course, is included as an important part of the subject matter. Schools generally, however, would consider plywood to be too specialized a subject to warrant setting up specialized courses of study. Undoubtedly, therefore, the technical developments in this field will continue to come from engineers, foresters, and others who have had a more general education, broader in scope, which they will apply to the problems in plywood development as they arise. This, of course, is true also of other fields. The entire trend in education is in the direction of broad fundamental training rather than specialization. It can only be hoped that in the future this will lead to continuing development and improvement in materials in general, including plywood and its closely associated materials.

COMMENT BY HENRY S. JONES[6]

It is obvious that the author writes from long association with the plywood industry, and has devoted a great deal of time and effort in securing the information presented. The result is a readable and factual history of the industry, and the author is to be congratulated for the fine work he has done in assembling this material.

As an associate of the Roddis Plywood Corporation, the writer regrets that he must take issue with the author regarding the origin of the solid-core flush door, and the dates given.

Mr. Hamilton Roddis did pioneer the development of the door, but he states that the original idea for the solid-core flush door came from the architectural department of the Pullman Company in the late nineteenth century, for use in Pullman cars of that period. The first company to offer a solid-core flush door to the public was the American Compound Door Company of Chicago. In 1907 Mr. Hamilton Roddis began experimenting with this type of door and marketed it in a small way in 1908.

In the early period, this type of door met with considerable sales resistance

[1] Forest Products Laboratory, Madison, Wis.

[2] "Plywood Is Engineered Wood," by T. D. Perry, MECHANICAL ENGINEERING, vol. 74, October, 1952, pp. 787–796.

[3] "Waste in Veneer Manufacturing," by E. M. Davis, Forest Products Laboratory Report No. R1493.

[4] "Reduction of Waste in the Veneer and Plywood Industry," by H. O. Fleischer, Forest Products Laboratory Report No. R1666-4.

[5] Professor of Structural Engineering, Department of Building Engineering and Construction, Massachusetts Institute of Technology, Cambridge, Mass. Mem. ASME.

[6] Assistant to the President, Roddis Plywood Corporation, Marshfield, Wis. Mem. ASME.

on the part of the established manufacturers of panel doors, and to some extent from architects. It wasn't until after World War I that the utility and appearance of the solid-core flush door began to have wide appeal, but by 1918 the door had really come into its own.

Probably one of the first big users was the Statler Hotel, who found that maintenance was far less than for any other existing door. It is still a standard for all Statler Hotels, and today has become standard in nearly all public buildings.

One could cite many reasons for this trend. Utility and appearance have been mentioned previously. Their ability to withstand hard wear, and their fire-resistant qualities have been contributing factors.

Here it seems suitable to comment on the more recently developed semihollow-core flush doors. The author states, "It was not until about 1938 that the solid lumber core in flush doors was replaced by a semihollow core."

We do not consider the semihollow core door either a replacement or a substitute for the solid door. Each has its own use and market. The author states correctly that the semihollow-core flush door "substantially reduced the weight and brought down the cost to where flush doors could be widely used for homes in modest price ranges." There are other types of installations where it may be used satisfactorily. However, where hard use and fire-resistant qualities are required, the solid-core door has no substitute.

AUTHOR'S CLOSURE

The commendatory comments by all three discussors are appreciated.

With regard to the implications that Dr. Brouse attaches to Fig. 16 (with its caption "Veneer versus lumber yield; gross veneer product equals 92 per cent; lumber products equals 72 per cent . . . "), it was the author's intention to limit the graphic comparison to the primary yield from the log in rotary-cut veneer and in undried and unprocessed lumber, and not to carry it further. The percentage figures expressed in the caption do not take into account quality or grade, which it can be assumed are approximately equal, and are correct. There are inevitable further losses in converting veneer into plywood, as there are in converting lumber into any of its intermediate or end products. To that extent Dr. Brouse's conclusions appear to be unfair to plywood, unless he makes similar deductions for drying, planing, edging, and trimming lumber. It is quite true that much remains to be done in reducing waste in the wood-utilization industries, and Dr. Brouse's appeal for better lumber yields is most timely.

Referring to Dr. Dietz's comments with regard to education in the woodworking industries, no claim was set up in the paper that courses "in plywood as such" should be offered, but that more and better courses should be offered in wood utilization, including plywood as one of many wood products. It still remains true that comprehensive courses in diversified wood utilization are few and far between.

The correction by Mr. Jones called attention to errors by the author with regard to the date of the development of the flush door, and to the proper classification of a semi-hollow core plywood door as an alternate, rather than as a substitute for the solid-core door. Those corrections were made before the paper was published in the October issue of MECHANICAL ENGINEERING.

The author is most appreciative of the interest shown by these commentators and regrets that the original paper may not have been sufficiently clear on the points mentioned.

T. D. PERRY.[7]

[7] Engineer in Woodwork, Moorestown, N. J. Fellow ASME.

Steam Plants in Inland Rivers

TO THE EDITOR:

It is too bad that Mr. Williamson did not go into a little more detail as to the number of fans, boiler feed pumps and circulating water pumps incorporated per unit in the Meramec and Joppa stations described in his paper "New Features of Steam Plants in Inland Rivers" in MECHANICAL ENGINEERING for September, 1952, even though the inclusion of these facts is not implied in the title.

I am in thorough sympathy with Mr. Williamson's thesis, being primarily an operating man and having listened wearily many hours to designers piling safety precautions on safety precautions, many of which the operator would never remember or have time to use in an emergency.

I would, however, like to take issue with Mr. Williamson on a question of phraseology. On p. 724, he says: "More typically the cube root of 2 is 1.26 or a 160,000 kw unit would cost 26 per cent less than two 80,000 kw units."

I say that two 80,000 kw units would cost 26 per cent more than one 160,000 kw unit but that one 160,000 kw unit would cost $\frac{1.26 - 1.00}{1.26}$ or about 20.6 per cent less than two 80,000 kw units.

HENRY D. FISHER.[8]

AUTHOR'S CLOSURE

I appreciate Mr. Fisher's comments. More details on Meramec and Joppa will be covered in later publications. The "cube-root" rule on power-plant unit size and cost is only an empirical one. I would not dispute whether two 80's would cost 20.6 or 26 per cent more than one 160.

G. V. WILLIAMSON.[9]

[8] New Haven, Conn. Mem. ASME.

[9] Superintendent, Power Production, Union Electric Company of Missouri, Saint Louis, Mo.

U. S. Book Exchange

TO THE EDITOR:

The United States Book Exchange (USBE) for which the Engineers' Joint Council and 18 other professional societies and organizations, are cosponsors, is now in its fourth year.

Starting modestly with financial underwriting from certain foundations and government agencies and as a by-product of the postwar rehabilitation efforts for devastated libraries, USBE can now be classed as a permanent institution.

USBE operates internationally, primarily as a clearing house, for exchanging surplus or duplicate issues of magazines and books.

At a recent annual meeting of USBE it was reported that over three million publications have been received to date at the headquarters in the Library of Congress and 700,000 had been distributed selectively in this country and abroad. The inventory, as of December 1, 1952, contained 2,200,000 items, carefully indexed and classified by countries.

Participating libraries abroad number 330 and in the United States, 320. The records revealed also that in each year of operation, the area of service has widened and the unit costs of operation have decreased.

The correspondence files of the director,

Miss Alice D. Ball, reveal awareness among librarians generally, of the value of the scheme, especially for helping research workers who may be dependent on complete files for professional and other technical periodicals and for those who are currently aware that scientific developments are not all originating in any one country. Demands from both American and foreign libraries are predominantly for technical and scientific literature.

An example of the procedure of operation is briefly: a participating library finds it has an extra file of MECHANICAL ENGINEERING, ships it prepaid to USBE, and is credited with points representing the number of separate items in the lot. The monthly lists from USBE, which rotate selectively by areas, with constantly changing priorities, in order to distribute fairly the opportunity to make first choice in selections, reveals to a foreign or U. S. library the availability of this file of journals. With receipt of the order, shipment of the lot goes forward for a small fee, with the library paying transportation costs.

USBE inherited the unfinished business of the American Book Center which handled the vast distribution of books given by individuals and organizations to help libraries that suffered damage in the Second World War. It today acts as distributor for individuals and governmental agencies in handling such gifts.

In starting the fifth year current needs are: Securing funds to continue aid to such foreign libraries as are still too impoverished to pay necessary transportation costs and nominal handling charges per item; awakening more libraries abroad and also in the United States to the availability of the service; arousing more librarians to the need for noting missing items in their periodical files and for permitting USBE to act as the agency to provide such replacements.

The writer has represented EJC on the corporation since 1948. In addition to EJC, the following organizations are acting as sponsors of USBE: American Council on Education; American Council of Learned Societies; Library of Congress; National Research Council; Smithsonian Institution; Social Science Research Council; member organization of the Council of National Library Associations; American Library Association, ALA Public Libraries Division, American Association of Law Libraries, Association of American Library Schools, Association of College and Reference Libraries, Association of Research Libraries, Catholic Library Association, Medical Library Association, Music Library Association, National Association of State Libraries, Special Libraries Association, Theater Library Association.

Officers of the corporation for the current year and their affiliations are: president, Sidney B. Hill, American Association of Law Libraries; vice-president, Rev. James J. Kortendick, Catholic Library Association and Association of American Library Schools; secretary, Scott Adams, Medical Library Association; treasurer, Ralph L. Thompson, American Library Association, Public Libraries Division; Board of Directors: James S. Thompson, chairman, Engineers' Joint Council; Jack Dalton, secretary, librarian, University of Virginia; Charles W. David, Association of Research Libraries; John Fall, Association of College and Reference Libraries; and Helen L. Scanlon, Special Libraries Association. Raymond L. Zwemer, chief, Science Division, Library of Congress, is chairman of the finance committee.

JAMES S. THOMPSON.[10]

[10] Chairman of the Board, United States Book Exchange, Inc.; retired president, McGraw-Hill Book Co., Inc., New York, N. Y. Assoc. Mem. ASME.

Society of Professional Engineers

TO THE EDITOR:

I note with some interest the discussion of "engineering unity"[11] by Mr. Rolfe Johnson—particularly his reference to the National Society of Professional Engineers.

I, for one, have never been a supporter of this society and declined membership in its original organization because I felt that the engineering profession already had too many representing societies.

As is well known, the Engineers Joint Council, and prior to that, the American Engineers Council, were both organized as unity organizations for the engineering profession.

My only objection to the National Society of Professional Engineers is that they accept for membership almost wholly on a registration basis. I know that many men have been registered (possibly under the "grandfather" provisions) who are unqualified for membership in the technical societies, or even for practicing engineering under the stamp of registration.

This conclusion was reached after attempting for years to get registration in Louisiana for all branches of engineering. Facing serious opposition from the local civil-engineering group (who have always been registered in Louisiana), as well as from some of the government units in the state, registration in Louisiana was accomplished. Many are practicing engineering without complete qualifications other than the fact that they have been in sales work, or quasi-engineering activities prior to the passage of the registration law.

I do not mean to contest the statement that NSPE could be and possibly is, the logical agency for engineering unity, but I do doubt whether an organization that has such a small percentage of representation of the Founder Society membership as NSPE, can equitably represent the engineering profession. I sincerely hope that the engineering profession can develop a representative organization for the entire profession. If such an organization existed today engineers would have a better chance for proper consideration by the Armed Forces, and, I believe, our professional status would be greatly increased.

JAMES M. TODD.[12]

[11] "Engineering Unity," Communication published in MECHANICAL ENGINEERING, October, 1952, vol. 74, pp. 839–840.

[12] James M. Todd & Associates, New Orleans, La. Past-President and Fellow ASME.

The Mean Flow in Kaplan Turbines

TO THE EDITOR:

In order to correct an error which the writer failed to catch during the preparation of his paper published in the October, 1952, issue of the *Transactions*, the following information is given:

The vector ξ_0 introduced in section 4 (p. 1286) should be understood as the vector with the components

$$\xi_{0r} = 0$$

$$\xi_{0\theta} = \frac{\omega - \gamma_0/r^2}{V} \frac{d\gamma_0}{dr} - \frac{dV}{dr}$$

$$\xi_{0z} = 0$$

It is equal to the vorticity far upstream of the blades when $\gamma_0 = \text{const.}$

R. E. MEYER [13]

[13] I.C.I. Research Fellow, University of Manchester, Manchester, England; Visiting Research Associate, University of Maryland, College Park, Md.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Investment Castings for Engineers

INVESTMENT CASTINGS FOR ENGINEERS. By Rawson L. Wood and Davidlee Von Ludwig. Reinhold Publishing Corp., New York, N. Y., 1952. Cloth, $5^3/_4 \times 9$ in., figs, tables, bibliography, index, ix and 477 pp., $10.

REVIEWED BY R. W. BRECKENRIDGE[1]

THIS book presents information of use to those who design either the product to be manufactured or new equipment for producing it. It also presents information of use to those who operate the producing equipment and to those metallurgists who might be called upon to recommend alloys. The peculiarities of alloys that are being cast by this process are described quite fully.

The scope of the book is wide enough to include practically all of the successful processes that have been thus far developed. The adaptability of these processes to various requirements of finished castings, including limits of accuracy, makes the book of value to its readers in that it gives them a background for solving their own manufacturing problems.

The language is easily understood by readers other than those who are conversant with the finer points of investment casting and yet they are adequate for clear explanations. Numerous illustrations are used, most of which are copies of actual photographs.

The book is well indexed, which adds to its value for reference purposes. It is not a condensed short course for students who go no deeper than to learn that such processes exist. The number of case histories presented shows that the writing is backed up with a wealth of experience. Statements of limitations are freely given which takes the book out of the class of propaganda for a new method.

The bibliography appended consists largely of recent magazine articles, since books on the subject are still scarce. The bibliography is classified under other articles by the authors, a general bibliography, and technical trade publications.

The book is a pioneer in the creative field of this casting method and not a "rehash" of other books.

[1] Professor of production engineering, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa. Assoc. ASME.

Books Received in Library

ADVANCED MECHANICS OF MATERIALS. By Fred B. Seely and James O. Smith. John Wiley and Sons, Inc., New York, N. Y., second edition, 1952. Bound, $6 \times 9^1/_4$ in., 680 pp., diagrams, tables, charts, graphs, $8.50. This textbook is intended for advanced undergraduate and first-year graduate students and continues the subject beyond the usual course in strength of materials. It aims to show the limitations of the ordinary formulas, to consider the conditions under which the limitations are significant, and to extend the subject to more complex topics. It also endeavors to give a more comprehensive view of the fundamental concepts and methods used in stress analysis. In addition to extensive revision throughout, two new parts have been added: influence of small inelastic strains on load-carrying capacity of members, and introduction to instability—buckling loads.

ASTM STANDARDS ON TEXTILE MATERIALS. Prepared by ASTM Committee D-13 on Textile Materials. American Society for Testing Materials, Philadelphia, Pa., 1952. Paper, 6×9 in., 660 pp., illus., tables, diagrams, $5. The following wide range of topics is covered by the 99 specifications, test methods, and tolerances presented: asbestos, bast and leaf fibers, cotton, glass textiles, rayon and silk, wool, pile fabrics, and felt; general fibers, fabrics, yarns, threads, and cordage; identification qualitative and quantitative analysis; resistance to insect pests and microorganisms; testing machines. There are tests on snag resistance and stretch of hosiery and other specialized items. A group of useful tables is appended as well as certain proposed test methods, and an extensive glossary of textile terms is given including photographic illustrations of fabric defects.

DAVISON'S TEXTILE BLUEBOOK. The eighty-seventh year, July, 1952, edition. Davison Publishing Company, Ridgewood, New Jersey, 1952. Bound, $5 \times 8^1/_8$ in., 1463 pp., $6.50. A complete directory of textile mills and products. The information is arranged geographically under product, raw materials, dealers, and manufacturers. There are alphabetical indexes giving name of proprietor and mills of all textile manufacturers, dyers, finishers, and so on, in the United States and Canada. Lists of textile schools, laboratories, associations, and other pertinent items are included.

ELASTICITY IN ENGINEERING. By Ernest E. Sechler. John Wiley & Sons, Inc., New York, N. Y., 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 419 pp., charts, graphs, tables, diagrams, $8.50. This book is intended to fill the gap between strength of materials and theoretical elasticity, bringing into one volume the material the engineer needs for a background in the fundamental theories of stress and deformation of elastic bodies under load. The first section establishes the equations and assumptions underlying the whole field; the second illustrates the use of these principles in solving the problems of stable (nonbuckling) structures; and the third treats instability (buckling) problems. The last two sections discuss approximate methods of solving problems too complex for formal proof.

HEAT TRANSFER PHENOMENA. By R. C. L. Bosworth. John Wiley and Sons, Inc., New York, N. Y., 1952. Bound, $5^3/_4 \times 8^3/_4$ in., 211 pp., illus., graphs, tables, $6.50. Heat flow is described as a type of transport process in which physical characteristics are transferred through the movement of certain "carriers." It is in this light that the conduction of heat in gases, liquids, and solids, radiative transfer, forced and natural convection, and heat flow with simultaneous phase change are explained. An analogy of heat flow to other transport phenomena completes this monograph which should prove useful both to advanced students and technologists.

LEGAL GUIDE FOR CONTRACTORS, ARCHITECTS, AND ENGINEERS. By I. Vernon Werbin. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, 374 pp., $4.75. A concise review of typical problems in connection with construction contracts which describes 83 actual situations in the breaching and changing of contracts, and so on, situations of the sort that frequently lead to litigation, and tells how the courts viewed each case. Facts and contract provisions involved are given in each situation, and cases are cited to sustain the principles of law set forth.

MATERIALS HANDLING MANUAL. Edited by Carl C. Harrington. Conover-Mast Publications, Inc., New York, N. Y., 1952. Bound, $6 \times 8^3/_4$ in., 434 pp., illus., diagrams, charts, $6. Organized for easy reference, this manual covers every major type of materials-handling equipment under 24 major classifications. In addition to the basic descriptive information the book is intended as a definite guide to the most effective and economical equipment for any particular job. Proper installation and maintenance methods are explained and adaptations for use in special circumstances are indicated.

NATIONAL FIRE CODES. Volume 2. The Prevention of Dust Explosions, 1952. Sponsored by National Fire Protection Association and approved by the American Standards

Association. National Fire Protection Association, Boston, Mass., supersedes 1950 edition, 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 288 pp., diagrams, charts, $3. A compilation of codes established for a wide variety of industries in which dust concentrations are a hazard. Safety methods and precautions are specified for buildings, equipment, operating methods, and other pertinent aspects. Static electricity and explosion venting are discussed separately in appendixes, and there is an extensive listing of dust explosions in the U. S. classified by dust types.

PIPE RESISTANCE. For Hydraulic, Lubricating, and Fuel Oils, and Other Nonaqueous Liquids. By T. E. Beacham. E. & F. N. Spon Limited, London, England, 1951. Bound, $6^1/_2 \times 10$ in., 61 pp., charts, 18s. The author's object is to provide a simple and accurate means of estimating pipe resistance for all engineers, designers, and research workers concerned with the flow of nonaqueous liquids. A feature of the book is the series of pipe-resistance diagrams covering a wide range of conditions by means of which pipe sizes can be determined with ease and precision. A full explanation of the construction and use of the diagrams is given.

PROCEEDINGS OF THE FOURTH ANNUAL INDUSTRIAL ENGINEERING INSTITUTE. Edited by Donald G. Malcolm. University of California, College of Engineering, Berkeley and Los Angeles, Calif., 1952. Paper, $8^3/_4 \times 11$ in., 89 pp., illus., diagrams, charts, graphs. Twenty-two papers are presented dealing with a wide range of topics within the industrial-engineering field: time-study methods and training; performance rating and standards; kinematic analysis of body motions; quality control, sampling, and inspection methods; incentives and personnel work.

STEAM POWER STATIONS. By Gustaf A. Gaffert. McGraw-Hill Book Company, Inc., New York, N. Y., fourth edition, 1952. Bound, $6^1/_2 \times 9^1/_4$ in., 637 pp., tables, graphs, diagrams, illus., charts, $8. This book, now in its fourth edition, is a standard text on the mechanical-engineering features of steam power plants. It covers the construction of the various types of equipment, design, and performance characteristics, costs and economies, and the integration of all machinery. The new edition has been revised to include recent data on such new developments as the extraction cycle technique, pressurized furnaces, axial-flow fans, and cyclone firing—all presented largely from a design and construction point of view and comprehensible at the engineering-college level.

SYMPOSIUM ON STATISTICAL ASPECTS OF FATIGUE. American Society for Testing Materials, Philadelphia, Pa. (Special Technical Publication, No. 121), 1952. Paper, 6×9 in., 64 pp., graphs, tables, $1.75. The three papers on fatigue of materials presented in this pamphlet discuss the planning and interpretation of fatigue tests, describe methods for the determination of the character and dispersion of fatigue life and endurance limits, and explain the statistical analysis and graphical representation of fatigue data.

TABLES OF THE ERROR FUNCTION AND OF ITS FIRST TWENTY DERIVATIVES. (Annals of the Computation Laboratory of Harvard University, vol. 23), Harvard University Press, Cambridge, Mass., 1952. Bound, $8 \times 11^1/_4$ in., 276 pp., tables, $8. The present volume of six-place tables has been prepared to meet the need for a new and more nearly complete table of the normal error function and its derivatives. Fundamental in statistical work, these functions are applicable in a large class of physical problems such as noise and communications, heat flow, kinetic theory of gases, hydrodynamics, and wave mechanics. An explanatory introduction precedes the tables.

THEORY OF ELASTICITY AND PLASTICITY. (Harvard Monographs in Applied Science, No. 3.) By H. M. Westergaard. John Wiley & Sons, Inc., New York, N. Y., 1952. Bound, $5^3/_4 \times 8^1/_2$ in., 176 pp., $5. Suitable for first-year graduate students, this book is written from the point of view of the engineer although the treatment is entirely theoretical. Topics covered include the important basic concepts of the states of stress and strain, the basic laws and equations of elasticity and plasticity, and specialized applications to hollow cylinders, spheres, and so on, to various force effects, and to thermal stresses.

WEIGHT-STRENGTH ANALYSIS OF AIRCRAFT STRUCTURES. By F. R. Shanley. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 394 pp., charts, graphs, tables, $8.50. This volume is intended to provide scientifically sound methods of analyzing and predicting the structural weight of aircraft and missiles. Part 1 discusses methods by which the minimum weight can be determined for any material and conditions of loading. These principles of design for minimum weight are then utilized to derive weight equations for wing and fuselage structures, comprising Part 2. Part 3 includes a number of reports prepared in the course of investigations of new materials and extreme operating conditions.

ZAUBERWELT DER NORMZAHLEN. By Wilhelm Strahringer. Verlags- und Wirtschaftsgesellschaft der Elektrizitätswerke, Frankfurt am Main, Germany, 1952. Paper, $5^3/_4 \times 8^1/_4$ in., 95 pp., tables, charts, 6.50 Dm. The author describes a variety of uses for "preferred number" series in the fields of production and distribution, economics and management, and any other activities to which standardization of this sort may be applied. Graphs are freely used for efficient representation of these applications. The official German standard series of preferred numbers, of which the base term is 1 and the ratio is $\sqrt[40]{10}$, is the particular series on which the book is based.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretation was formulated at the Committee meeting December 12, 1952, and previously, and approved by the Board on February 2, 1953.)

CASE NO. 897-4 (REOPENED)

(Special Ruling)

Inquiry: May chrome-nickel austenitic steels as such, or alloyed with columbium, titanium, or molybdenum, be used in the construction of unfired pressure vessels under ASME Code rules?

Reply: Chrome-nickel austenitic steels as such, or alloyed with columbium, titanium, or molybdenum, may be used in the construction of unfired pressure vessels without consideration of their corrosion or heat resistant properties (note appendix for recommendations), provided the rules of design, fabrication, and inspection of the Code are followed except as follows:

(1) *Specifications*

(a) The alloy chrome-nickel material may be any Austenitic Grade of such material made to any approved SA specification that is included in Section II. Other physical forms made to the same specifications as far as possible may be used provided in particular that the mechanical strength requirements of the specification be met.

The addition of columbium to the M grade of Specification SA-240 is permitted. The amount shall not exceed that specified in Specification SA-240 for the C grade. For optimum resistance to formation of sigma phase (brittle) material a more restricted analysis than

permitted by Specification SA-240 has been found advisable, as follows:

Carbon	0.07 max %
Chromium	17.50–19.00%
Nickel	13.00–15.00%
Molybdenum	2.00–2.50% (2.25 preferred)
Columbium	9 times carbon content; 0.9 max %
Manganese	1.50 min %
Silicon	0.75 max %
Sulphur	0.03 max %
Phosphorus	0.03 max %

This grade of material shall be marked "Mc" for identification.

The addition of columbium to Grade 8, Type 309, of Specification SA-167 is also permitted. The carbon content of this grade shall be limited to 0.08 per cent and the columbium content shall be not less than 10 times the carbon content nor more than 1.00 per cent. This grade of material shall be marked "309 Cb" for identification.

(2) *Impact Testing*

Impact tests as provided in Par. U-142 shall be required for the following combinations of materials and operating temperatures:

(a) For all materials at operating temperatures below —325 F.

(b) For the following materials at operating temperatures below —20 F:

(1) Materials with carbon content in excess of 0.10 per cent.

(2) Materials that have a nickel or a chromium content in excess of the AISI standard analysis range of the specified type number and physical form.

(3) Material in casting form.

(4) Material in the form of deposited weld metal.

(c) For the following materials at all values of operating temperatures:

(1) Types 309, 310, 316, 309 Cb, 310 Cb, or 316 Cb material that is heat treated at temperatures below 1650 F. The tests shall include the weld metal and shall be made at room temperature or at the operating temperature if lower.

(3) *Heat Treatment*

(a) Heat-treatment, including stress relief, of welded vessels is neither required nor prohibited. The need for and the details of heat treatment depend on the type of alloy steel and service conditions. The appendix to this Case gives some general suggestions.

(b) A welded joint efficiency of 95 per cent shall be permitted on vessels constructed to the requirements of Pars. U-68 and U-200 only if the finished welds are heat treated at a temperature over 900 F; otherwise the joint efficiency shall be limited to 90 per cent.

(4) *Thickness Limitations*

The Code limitations on thickness shall apply except that the minimum thickness permitted is $^1/_{16}$ in. for non-corrosive conditions of service and $^3/_{32}$ in. for corrosive conditions of service. (See Appendix for cautionary note about heat-treating thick sections.)

(5) *Temperature Limitations*

The Code limitations on service temperature shall apply to the various types of construction.

(6) *Allowable Working Stresses*

For Par. U-68 and Par. U-69 vessels the maximum allowable working stresses shall be those given in Table U-2 and when the operating temperature is below —20 F the allowable working stress shall be that given in the table for —20 F to 650 F. For Par. U-200 and Par. U-201 vessels the maximum allowable working stresses shall be 1.25 times those for Par. U-68 vessels at the same temperature. For Par. U-70 vessels the maximum allowable working stresses shall be 1.25 times the maximum allowable stresses given in Par. U-70(a) and (b) for carbon steel materials.

The maximum allowable working stresses for Grade Mc material shall be the same as permitted for Grade M material by the rules above for any temperature up to and including 1000 F maximum.

(7) *Fabrication and Testing*

(a) Fabrication shall be done and weld tests made in accordance with the requirements of the Code, including qualification of the welding procedure used and of the welding operators employed to meet the requirements of Section IX except as hereinafter.

When material having a carbon content of 0.15 per cent and over is to be used the welding procedure qualification tests shall be made using material having a carbon content within 0.02 per cent of the maximum used in construction. Heat-treatment of test specimens is not required but if used shall duplicate the treatment intended for the finished vessel.

The deposited weld metal shall have a carbon content not over that specified for the parts joined and have other elements within the AISI limits of composition for the grade of material used in the parts joined, except that when the fabricator is of the opinion that a physically better joint can be made by departure from these limitations and the user and the inspector are satisfied that the corrosion resistance will be sufficient for the intended service, these limitations may be waived. When columbium is used in the weld metal it shall not exceed 1.00 per cent and when titanium is used it shall not exceed 0.6 per cent. Columbium may be substituted for titanium in weld metal.

(8) *Inspection*

(a) All welds, both butt and fillet, in vessels whose shell thickness exceeds $^3/_4$ in. shall be examined for the detection of cracks by the fluid penetrant method. This examination shall be made following heat-treatment if heat-treatment is performed. All cracks shall be eliminated.

(b) All vessels over $1^1/_2$ in. in shell or head thickness which are heat-treated shall be radiographed following heat-treatment.

NON-MANDATORY APPENDIX

Suggestions on the Selection and Treatment of Austenitic Chromium-Nickel Steels

A-1 *General* The selection of the proper metal composition to resist a given corrosive medium and the choice of the proper heat-treatment and surface preparation of the material selected are not within the scope of the Code. This Appendix discusses some of the factors that should be considered in arriving at a proper selection.

A-2 *Structure* The composition, mechanical working, heat-treatment cycle, and the solidification rate in castings and weld metal largely determine the degree to which ferrite, carbide, and sigma phases are formed in austenitic stainless steels. The type of structure and the thermal and mechanical treatment it receives are determining factors in its resistance to intergranular corrosion, stress corrosion cracking, and crack-susceptibility, and in its ductility and toughness.

A-3 *Intergranular Corrosion* When austenitic steels are held for a sufficient time between 800 F and 1600 F, chromium carbide tends to precipitate preferentially at austenite grain boundaries. This type of precipitation is referred to as sensitization. Intergranular corrosion takes place when a sensitized material is exposed to a sufficiently strong corrosive medium for a long enough time.

Methods for combating intergranular corrosion include the following:

(1) An anneal at 1850 F to 2050 F followed by rapid cooling through the sensitization range. Subsequent operation of a vessel in the sensitization range may resensitize the material.

(2) Stabilizing with columbium, titanium, or tantalum. These elements have a strong affinity for carbon and, in sufficient quantities, prevent the precipitation of chromium carbides.

(3) Use of types of steel having a low enough carbon content that the chromium depletion at the grain boundaries is kept within safe limits.

A-4 *Stress-Corrosion Cracking* Austenitic chromium-nickel steels that are highly stressed in tension may develop transcrystalline or intercrystalline cracks when exposed to certain corrosive media. The stresses may be produced by external loads, by welding or cold-forming operations, or by uneven cooling. Methods of reducing susceptibility to stress-corrosion cracking include the selection of a composition that will have a stable austenite structure in the operating range and heat-treatment to reduce the magnitude of the residual stresses.

A-5 *Formation of Sigma Phase* The existence of the sigma phase in an austenitic stainless steel may materially reduce its ductility and toughness. Under favorable conditions, the sigma phase is formed relatively slowly in the temperature range between 1050 F and 1700 F. Factors contributing to the formation of sigma phase include the presence of ferrite, prior cold-working, variation in composition due to progressive solidification, and the presence of ferritizers, particularly molybdenum, columbium, and titanium. Formation of sigma phase may be minimized or prevented by a proper selection of composition. Or the sigma phase may be transformed into austenite and ferrite by suitable heating and quenching.

A-6 *Heat-Treatment of Austenitic Chromium-Nickel Steels* (a) In recognition of controversial opinion relative to the effects of thermal stress-relief of austenitic stainless steels, mandatory requirements for such have been omitted. Service experience is too limited to permit comparison between the relative safety of as-welded and stress-relieved austenitic steel weldments, particularly in thick sections. It is recognized that the stability of austenitic steels and their optimum behavior in service is influenced by the mechanical and thermal treatment they have received; however, it is a basic principle that the Code rules are intended to provide minimum safety requirements for new construction, not to cover deterioration which may occur in service as a result of corrosion, instability of the material, or unusual operating conditions such as fatigue or shock loading.

(b) Where maximum corrosion resistance is required it is advisable to heat-treat in such a fashion as to place all chromium carbides in solution. For such service it is recommended that the following procedure be followed:

(1) Hold the vessel within the prescribed temperature range for not less than one hour per inch of thickness. Quench all parts of the vessel uniformly and as rapidly as possible. Material not stabilized with columbium or titanium should be cooled through the range from 1700 F to 1000 F in not more than three minutes. The rapid cooling should be continued to below 800 F. Slower cooling rates may be just as satisfactory for some compositions of the material and conditions of service.

Table A-6 Recommended Temperature Ranges for Heat-Treatment

Type Number of Material	Heat-Treatment Procedure
301, 302, 304, 308, 309, 310	1850-2000 F
321, 347	1850-2000 F
316	1850-2050 F
309 Cb, 310 Cb, 316 Cb	1850-1950 F

A-7 *Dissimilar Weld Metal* The difference between the coefficients of expansion of the base material and the weld should receive careful consideration before undertaking the welding of ferritic-type stainless steel with austenitic electrodes for services involving severe temperature conditions, particularly those of a cyclic nature.

A-8 *Fabrication* It is recommended that the user of austenitic chromium-nickel steel vessels in corrosive service consider the following additional fabrication test:

A welded test plate to provide a guided-bend test specimen should be made as prescribed in Section IX from one of the heats of material used in the shell. The test plate should be welded by the procedure used in the longitudinal joints of the vessel and should be heat-treated using the same temperature cycle as used for the vessel. The operation on the test plate should be such as to duplicate as closely as possible the physical conditions of the material in the vessel itself.

Grind and polish the specimen and immerse it for not less than 72 hours in a boiling solution consisting of 47 cc concentrated sulphuric acid and 13 g of crystalline copper sulphate ($CuSO_4$, $5H_2O$) per liter of water. Then bend the specimen so as to produce an elongation of not less than 20 per cent at a section in the base metal $1/4$ inch from the edge of the weld. The metal shall show no sign of disintegration after bending.

Cases Annulled

The following Case Interpretations have been annulled by the Boiler Code Committee because the information that they afforded is now incorporated in the Code:

1063, 1081, 1083, 1113, 1123, 1148, and 1152.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers, 1949

PAR. P-23(g) Revise to read:

(g) When a steel or wrought-iron pipe is pierced with tube holes, the maximum allowable stress in the ligaments in pounds per square inch shall not exceed the values given in Table P-7 and the maximum allowable pressure shall be computed using the formula in this Paragraph with the value for S multiplied by the efficiency factor E, and otherwise in accordance with the rule in Par. P-180 provided the tube holes do not pierce the weld in the welded pipe and provided the pressure shall be not greater than that allowed for the unpierced pipe.

Material Specifications, 1949

EDITORIAL NOTE

The Boiler Code Committee has approved adding to Section II the following new specifications:

SB-152-51T, Specification for Copper Sheet, Strip and Plate.

SA-350-52T, Forged or Rolled Carbon Alloy Steel Flanges, Forged Fittings and Valves and Parts for Low-Temperature Service.

The stress values for Specification SA-350-52T as they will appear in Table UCS-23 are as follows:

Grade	Spec. Min. Tens. Str.	—20 to 650 F
LF-1	60,000	15,000
LF-3	70,000	17,500

ASME NEWS

With Notes on the Engineering Profession

Tentative Program for 1953 ASME Spring Meeting Offers Wide Variety of Technical Information

Meeting to Be Held at Deshler-Wallick Hotel, Columbus, Ohio April 28–30

TENTATIVE PROGRAM

AVAILABLE preprints of numbered papers may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y. Please order by number as listed in program. The tentative program follows:

TUESDAY, APRIL 28

8:30 a.m.

Registration

9:30 a.m.

Fuels (1)

Natural-Gas Peak-Load Problems in the Appalachian Area, by *C. T. Konecny* and *B. J. Clarke*, Columbia Gas System Service Corp.

An Investigation of the Burning Characteristics of Pulverized Cinders, by *John M. Allen*, Battelle Memorial Institute (Paper No. 53—S-2)

An Instrument for Estimating the Density of Smoke in Stack Effluent, by *John P. Strange*, Mine Safety Appliances Co. (Paper No. 53—S-3)

9:30 a.m.

Management (1)

Panel Discussion on A Unified Theory of Organization and Management

The State of Management Theory, by *R. T. Livingston*, Columbia University

The Interdependence of the Behavior Sciences, by *D. B. Hertz*, Columbia University

Toward a Mathematical Theory of Organization, by *Merrill M. Flood*, Rand Corp.

The Measurement of Organized Behavior, by *H. Simon*, Carnegie Institute of Technology

Some Closing Observations on Organized Behavior, by *E. H. Schell*, M.I.T.

9:30 a.m.

Rubber and Plastics (1)

Polytetrafluoroethylene—Its Properties and Uses, by *L. W. Cornell*, Minnesota Mining and Manufacturing Co.

Unplasticized Polyvinyl Chloride—The Dawn of a New Era in Corrosion Protection, by *George S. Laaff*, Bolta Co.

Metal-Clad Laminates Used in Printed Circuitry, by *Norman A. Skow*, Synthane Corp.

9:30 a.m.

Metal Processing (1)—Production Engineering (1)

The Effects of Cold Drawing, Microstructure, and Thermal Treatments on the Machinability and Mechanical Properties of Carbon and Alloy Steel, by *Ford E. Dreves*, Wyckoff Steel Co. (Paper No. 53—S-8)

A Plastic-Flow Problem Arising in the Theory of Discontinuous Machining, by *E. H. Lee*, Brown University

9:30 a.m.

Gas Turbine Power (1)

Some Theoretical Aspects of Centripetal Turbines, by *R. L. Robinson*, AiResearch Manufacturing Co.

The Elastic-Fluid Centripetal Turbine for High Specific Outputs, by *Rudolph Birmann*, De Laval Steam Turbine Co.

12:15 p.m.

President's Luncheon

Presiding: Prof. *Samuel R. Beitler*, Ohio State University, Columbus, Ohio
Speaker: The President, *Frederick S. Blackall, jr.*, Fellow ASME

2:30 p.m.

Gas Turbine Power (II)

Calculation of Transpiration-Cooled Gas-Turbine Blades, by *John N. B. Livingood*, National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory, and *E. R. G. Eckert*, University of Minnesota

An Interferometric Study of the Boundary Layer on a Turbine Nozzle Blade, by *C. R. Faulders*, Massachusetts Institute of Technology

Possible Range of Turbojet Engine Design Within Specified Turbine Design Limits, by *Robert E. English* and *Richard H. Cavicchi*, National Advisory Committee for Lewis Flight Propulsion Aeronautics Laboratory

2:30 p.m.

Management (II)

Linear Programming and Production, by *George B. Dantzig*, Rand Corp.

COAL-LOADING MACHINE BUILT BY JEFFREY MANUFACTURING COMPANY, COLUMBUS, OHIO, ONE OF THE PLANTS TO BE VISITED DURING ASME SPRING MEETING

(This view in coal mine shows a Jeffrey Type L-600 track-type loading machine gathering the shot-down coal at the face and delivering to mine cars at the rear. This machine has a loading rate of six tons per min in loose coal.)

Statistical Decision Theory and Its Effect on Production Management, by *Robert Beckhofer*, Cornell University

Operations and Research and the Practicing Industrial Engineer, by *K. O. William Sanberg*, General Electric Co.

2:30 p.m.

Power (I)—Fuels (II)

Rehabilitation of an Industrial Power Plant, by *C. E. Morrow* and *R. F. Born*, Western Electric Co.

Overfire Air Installation at the Conners Creek Power Plant, by *James W. Campbell* and *Richard J. Travis*, The Detroit Edison Co.

2:30 p.m.

Rubber and Plastics (II)

Reinforced Plastics Connector Rings and Bolts for Fastening Timbers, by *H. A. Perry, Jr.*, Naval Ordnance Laboratory

Reinforced Plastic Laminates for Aircraft Use, by *D. Rossato*, Wright Air Development Center

The Navy Looks at Structural Plastics, by *W. R. Graver*, Bureau of Ships

2:30 p.m.

Metal Processing (II)—Production Engineering (II)

Spark Testing (A sound motion picture in color), by *Edsel E. Bishop*, Wyckoff Steel Co.

Chip Breakers—A Study of Three-Dimensional Chip Flow, by *E. H. Henriksen*, Cornell University (Paper No. 53—S-9)

8:00 p.m.

Junior

Speakers: *G. F. Nordenholt*, editor, Product Engineering, and *Everett S. Lee*, editor, *General Electric Review*, General Electric Company
Subject: **Engineering—Opportunity Unlimited**

Guests of the Old Guard—Representing Sections:

West Virginia T. C. Phillips	**Cincinnati** Edward J. Goetz, Jr.
Youngstown Donald L. Block	**Akron** James W. Gorham
Cleveland Harold Hudacheck	**Columbus** John Mooney
Canton-Alliance-Massilon R. F. Cornish	**Pittsburgh** Richard A. Cederberg

8:00 p.m.

Management (III)

Panel Discussion on An Application to Engineering Cost Estimating

A Multidisciplinary Analysis of Engineering Cost Estimating (A Case History), by *K. T. Korn*, Edward A. Berk and Associates

From the Point of View of the Clinical Psychologist, by *Marjorie B. Creelman*, West Reserve University

From the Point of View of the Engineer, by *Harold R. Nara*, Case Institute of Technology

From the Point of View of the Communication Theorist, by *Anatol Rapoport*, University of Chicago

8:00 p.m.

Oil and Gas Power

A Photographic Study of Events in a 14-Inch, 2-Cycle Gas Engine, by *Ralph L. Boyer*, The Cooper-Bessemer Co., and *C. D. Miller*, Battelle Memorial Institute

Investigation of Flame Temperatures in A Single-Cylinder Spark-Ignition Engine, by *J. H. Potter* and *R. B. Dillaway*, University of Illinois

WEDNESDAY, APRIL 29

8:00 a.m.

Registration

9:30 a.m.

Gas Turbine Power (III)

Performance of Free-Piston Gas Generators, by *J. J. McMullen*, Navy Dept., U. S.

Applications For the Free-Piston Engine, by *J. J. McMullen*, Navy Dept., U. S. and *Robert P. Ramsey*, Cooper-Bessemer Co.

The Development of High-Output Free-Piston Gas Generators, by *Frank M. Lewis*, Massachusetts Institute of Technology, and *Robert A. Lasley*, Baldwin-Lima-Hamilton Corp.

9:30 a.m.

Fuels (III)

Heavy-Duty Operation of Spreader Stokers, by *M. W. Jones*, Columbia-Southern Chemical Corp.

Dust Emissions From Small Spreader-Stoker-Fired Boilers, by *Elmer J. Boer*, Bituminous Coal Research, Inc., and *Charles W. Porterfield*, Pocahontas Fuel Company, Inc.

Mill Drying in Pulverizing High-Moisture Coals, by *W. C. Rogers*, Riley Stoker Corp.

9:30 a.m.

Power (II)

Symposium on Chemical Cleaning of Heat-Transfer Surfaces in Power Plants as Well as Other Power-Plant Equipment

Chemical Cleaning in Central Stations, by *P. H. Cardwell*, Dowell, Inc.

9:30 a.m.

Production Engineering (III)—Metal Processing (III)

Method X Electro-Spark Machining, by *C. R. Alden*, Ex-Cell-O Corp.

An Interferometer for Polished-Surface Examination, by *Ronald E. Sugg*, E. I. du Pont de Nemours & Co.

Economical Inspection-Procedures Based on Inspection-Cost Break-Even Point, by *L. W. Dockray* and *R. F. Garrett*, Western Electric Co. (Paper No. 53—S-4)

9:30 a.m.

Rubber and Plastics (III)

Symposium on Industrial-Rubber Molded Products

Progress in Manufacturing Methods in the Molded-Rubber-Products Industry, by *J. H. Gerstenmaier*, Goodyear Tire and Rubber Co.

Product and Mold Designing For Lower Ultimate Cost, by *John K. Mason*, Firestone Industrial Products Co.

New Product Engineering, by *Howard H. Armstrong*, The B. F. Goodrich Co.

Mechanical Properties of High Mooney Elastomers, by *Merle Sanger* and *Paul Earley*, General Tire and Rubber Co.

12:15 p.m.

Roy V. Wright Lecture

Presiding: The President, *Frederick S. Blackall jr.*, Fellow ASME
Speaker: The Honorable *Frank J. Lausche*, Governor, State of Ohio, Columbus, Ohio

2:00 p.m.

Plant Trips

Among the various plant trips scheduled for the Spring Meeting are the following: Jeffrey Manufacturing Co., North American Aviation Co., Ternstedt Division of General Motors Corp., Ohio State University, Battelle Memorial Institute, National Electric Coil, Denison Engineering Co., and The Diamond Power Specialty Corp.

7:00 p.m.

Banquet

Toastmaster: *E. H. Davis*, New York Coal Sales Co., Columbus, Ohio
Speaker: *James F. Lincoln*, president, The Lincoln Electric Co., Cleveland, Ohio
Subject: **Incentive Management**

THURSDAY, APRIL 30

8:30 a.m.

Registration

9:30 a.m.

Gas Turbine Power (IV)—Fuels (IV)

Ceramic-Coated Low Alloys For Jet-Engine Hot Parts, by *John V. Long*, Solar Aircraft Co.

The Mechanism of Disintegration of Liquid Sheets, by *J. Louis York*, *H. E. Stubbs*, and *M. R. Tek*, University of Michigan

Thermodynamic Properties of Combustion Gases, by *Gilbert S. Bahn*, General Electric Co.

9:30 a.m.

Hydraulic—Fluid Meters

Results of the Test Program on Eccentric and Segmental Orifices, by *S. R. Beitler*, Ohio State University

Mixing and Equilibrium in Pipe Flow, by *Willis H. Carrier* (deceased), and *W. S. Misener*, Carrier Corp.

The Unsteady-Flow Water Tunnel at the Massachusetts Institute of Technology, by *James W. Daily*, Massachusetts Institute of Technology, and *Kenneth C. Deemer*, University of Kansas

9:30 a.m.

Machine Design (I)

A Proposed Standard Design For General Industrial Coarse-Pitch Worm Gearing, by *Frank G. East*, Hamilton Gear & Machine Company, Ltd. (Paper No. 53—S-6)

Natural Frequency of a Nonlinear System Subjected to a Nonmassive Load, by *C. E. Crede*, The Barry Corp. (Paper No. 53—S-10)

9:30 a.m.

Production Engineering (IV)—Metal Processing (IV)

Distribution of Shear Zone Heat in Metal Cutting, by *W. C. Leone*, Carnegie Institute of Technology. (Paper No. 53—S-7)

On the Analysis of Cutting-Tool Temperatures, by *M. C. Shaw* and *E. G. Loewen*, Massachusetts Institute of Technology

2:30 p.m.

Machine Design (II)—Lubrication

Some Vibration Effects on Surfaces Produced by Turret Lathes, by *P. T. Eisele* and *R. F. Griffin*, The Warner & Swasey Co. (Paper No. 53—S-12)

Bearing Design Using Concentric Journal Theory, by *R. R. Slaymaker*, Case Institute of Technology (Paper No. 53—S-11)

Design of 180-Degrees Partial-Offset Journal Bearing, by *Kwang-tzu Yang*, Illinois Institute of Technology

2:30 p.m.

Process Industries

Industry's Stake in the Ohio Valley Pollution-Control Program, by *Edward J. Cleary*, Ohio Valley Water Sanitation Commission

Some Engineering Aspects of Air Pollution Control, by *George W. Blum*, Case Institute of Technology

2:30 p.m.

IIRD

An Analysis of the Dynamics of Hydraulic Servomotors Under Inertia Loads and the Application to Design, by *H. Gold*, *E. W. Otto*, and *V. L. Ransom*, National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory. (Paper No. 53—S-1)

Phase-Plane Analysis—A General Method of Solution for Two-Position Process Control, by *Donald F. Eckman*, Case Institute of Technology

Dynamic Operation of a Force-Compensated Hydraulic Throttling Valve, by *Franz B. Tuteur* and *John L. Bower*, Yale University

2:30 p.m.

Heat Transfer

The Effect of Fin Geometry on the Performance of Heat-Exchanger Surfaces, by *W. E. Hilding*, University of Connecticut

New Aspects of Natural-Convection Heat Transfer, by *Simon Ostrach*, National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory

Heat Transfer and Fluid Friction For Fully Developed Turbulent Flow of Air and Supercritical Water With Variable Fluid Properties, by *R. G. Deissler*, National Advisory Committee for Aeronautics, Lewis Flight Propulsion Laboratory

Women's Program

Registration: Deshler-Wallick Hotel, April 28 and 29, all day

Tuesday, April 28

9:30 a.m.	Registration Coffee
12:30 p.m.	President's Luncheon
3:00 p.m.	Tea with Mrs. Frank Lausche, Governor's Mansion, 1234 East Broad Street
	Program: Mrs. Elmer Kaiser will present "Famous Ohio Ladies 1803–1953"

Hostesses: Mrs. Samuel Beitler
Mrs. J. Mason Pilcher

8:00 p.m. Musical at the home of Mrs. Elmer Kaiser, 2406 Brixton Road

Program: Louise Yost McDonald—Vocalist, Mrs. S. H. Yost—Accompanist.

Wednesday, April 29

9:30 a.m. Registration
Coffee

10:00 a.m. Tours on request (no charge)

12:30 p.m. Luncheon at the Scioto Country Club
Cards

Hostesses: Mrs. Ralph Sherman
Mrs. S. H. Yost

6:30 p.m. Cocktails

7:00 p.m. Banquet—Deshler-Wallick Hotel

Thursday, April 30

1:00 p.m. Luncheon at the Maramor, 137 East Broad St.

Hostesses: Mrs. Harry Ballman
Mrs. Walter Robinson

Second American Power Conference to Be Held in Chicago

Sherman Hotel, March 25–27, 1953

THE second annual meeting of the American Power Conference will be held on March 25-27, 1953, at the Sherman Hotel in Chicago, Ill. The conference is sponsored by the Illinois Institute of Technology in cooperation with nine universities and ten local and national engineering societies.

The American Power conference is the continuation of the Midwest Power conference. The name was changed because of the national significance of the previous meetings.

During the course of the sessions there will be symposiums on water problems of American industry, large steam turbines, large electrical generators, industrial and institutional plant operation, gas turbines, and network analyzers. Scheduled for the opening evening of the meeting is a forum on the industrial use of atomic energy.

The purpose of the Conference is to provide a forum for the exchange of information in the fields of power generation, transmission, distribution, and utilization.

The tentative program follows:

WEDNESDAY, MARCH 25

3,000,000-Kw Operating Experience With Modern Reheat, by *Otto de Lorensi*, Combustion Engineering-Superheater, Inc., New York, N. Y.

Trends Indicating Possibilities in Future Boiler Designs, by *G. W. Kessler*, The Babcock & Wilcox Company, New York, N. Y.

Symposium on Water Problems of American Industry

Panel Discussion: **Water Resources of America**
Joseph C. McCabe, Power, New York, N. Y.
L. N. Rowley, Power, New York, N. Y.
B. G. A. Skrotzki, Power, New York, N. Y.

Waste Disposal and Stream Pollution From the Point of View of Industry, by *H. W. Gehm*, National Council for Stream Improvement, Inc., New York, N. Y.

Problems of Waste Disposal and Stream Pollution From the Point of View of the Public, by *E. J. Cleary*, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio

High-Voltage Power Transmission in the Pacific Northwest, by *S. E. Schultz* Bonneville Power Administration, Portland, Ore.

Full-Scale Structure Tests of 230-Kv "H" Frames, by *W. A. Schuls*, Public Service Company of Indiana, Inc., Plainfield, Ind.

Some Control Circuits for Use of Multiple Fuel Firing On Boilers, by *H. Ziebols*, Askania Regulator Co., Chicago, Ill.

Trends in Combustion and Steam Temperature Control, by *P. S. Dickey*, Bailey Meter Co., Cleveland, Ohio

Double-Contingency Outages in Secondary Network Systems, by *N. M. Neagle* and *D. R. Nelson*, General Electric Co., Schenectady, N. Y.

Overhead Primary and Secondary Distribution Networks, by *H. G. Barnett* and *D. F. Shankle*, Westinghouse Electric Corp., Pittsburgh, Pa.

Forum on The Industrial Use of Atomic Energy

The Atomic Energy Commission's Appraisal, by *G. E. Dean*, Atomic Energy Commission, Washington, D. C.

Engineering and Technical Problems, by *Walter Zinn*, Argonne National Laboratory, Chicago, Ill.

Economic Evaluation, by *W. L. Cisler*, The Detroit Edison Co., Detroit, Mich.

Changes in the Atomic-Energy Act, by *O. M. Ruebhausen*, New York Bar Association Committee on Atomic Energy, New York, N. Y.

Current Legislation, by chairman, Congressional Joint Committee on Atomic Energy

Summary, by *Murray Joslin*, Commonwealth Edison Co., Chicago, Ill.

THURSDAY, MARCH 26

Symposium on Large Steam Turbines

Development of the 3600-Rpm Turbine, by *H. R. Reese*, Westinghouse Electric Corp., Philadelphia, Pa.

Developments in Large Steam Turbines, by *Carl Schabtach*, General Electric Co., Schenectady, N. Y.

A Technique of System Economic Analysis Useful in Long-Range Planning, by *H. E. Campbell* and *E. H. Reilly, Jr.*, General Electric Co., Schenectady, N. Y.

A New Method of Area-Wide Generation Control for Interconnected Power Systems, by *N. Cohn*, Leeds & Northrup Co., Chicago, Ill.

Falcon Dam and Power Plants, by *J. B. White*, International Boundary and Water Commission, United States and Mexico, El Paso, Texas.

The Guayabo Hydroelectric Power Development, by *E. M. Fucik*, Harza Engineering Co., Chicago, Ill.

An Evaluation of Our Water Resources, by *A. M. Buswell*, Illinois State Water Survey, Urbana, Ill.

Alkalinity Reduction by an Approved Process of Anion Exchange, by *A. E. Kittredge*, American Water Softening Co., Philadelphia, Pa.

Voltage Flicker From Loads on Electrical Systems, by *Marvin Fisher, Jr.*, University of Illinois, Urbana, Ill.

Arc Furnaces—Light Flicker and Supply Systems, by *D. F. Shankle*, Westinghouse Electric Corp., East Pittsburgh, Pa.

The Generation and Use of Niagara and St. Lawrence Power in the Province of Ontario, by *R. L. Hearn*, Hydro-Electric Power Commission of Ontario, Toronto, Can.

The American Development of Power on the Niagara River, by *H. I. Howell*, Niagara Mohawk Power Corp., Buffalo, N. Y.

Operation and Performance of New University of Kentucky Earth Heat Pump, by *E. B. Penrod*, University of Kentucky, Louisville, Ky.

The Design and Manufacture of the Heat-Pump Water Heater, by *T. A. Hogdon*, Harvey Whipple, Inc., Springfield, Mass.

Symposium on Large Electrical Generators

Desirable Characteristics for Large Generators, by *J. B. McClure* and *C. E. Kilbourne*, General Electric Co., Schenectady, N. Y.

Inner Cooling of Turbine Generators, by manager, turbine generator section, generator engineering department, Westinghouse Electric Corp., East Pittsburgh, Pa.

Supercharged Cooling for Large Turbines, by *W. L. Ringland* and *L. T. Rosenberg*, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Operating Experience With Large Generating Units, by *R. P. Liversidge*, Philadelphia Electric Co., Philadelphia, Pa.

Preparation and Combustion of Jet-Pulverized Coal, by *C. G. Von Fredersdorff*, Institute of Gas Technology, Chicago, Ill.

Burning of Paper-Mill Waste Liquor, by *J. E. Hoest*, National Container Corp. of Wisconsin, Tomahawk, Wis.

Recent Advances in the Art of Heating Homes, by *R. W. Roose*, University of Illinois, Urbana, Ill.

Load-Limiting Controls for Electric House Heating, by *W. F. Friend*, Ebasco Services, Inc., New York

Long-Range Outlook for Liquid Fuels in America, by *Eugene Ayres*, Gulf Research & Development Co., Pittsburgh, Pa.

Use of Low-Rank Fuels in the United States, by *L. C. McCabe*, U. S. Bureau of Mines, Washington, D. C.

Use of Amines for Control of Iron Pickup, by *H. J. Guillory*, Central Louisiana Electric Co., St. Landry, La.

Prevention of Metal Losses in the Wet Steam Areas of Steam Turbines, by *F. L. Archibald* and *J. W. Purssell*, Boston Edison Co., Boston, Mass., and *F. G. Straub*, University of Illinois, Urbana, Ill.

FRIDAY, MARCH 27

Promoting the Installation of Residential Heat Pumps, by *G. S. Whitlow*, Union Electric Co., St. Louis, Mo.

New Application Techniques Improve Residential Air Conditioning, by *E. P. Palmatier*, Carrier Corp., Syracuse, N. Y.

Are Federal Power Practices Sound National Policy? by *E. R. de Luccia*, Pacific Power & Light Co., Portland, Ore.

The Materials Situation as Related to the Power Industry, by *J. F. Moore*, Ebasco Services, Inc., New York

Acid Regeneration of Cation Exchangers, by *F. A. Lindsay*, National Aluminate Corp., Chicago, Ill.

Factors Influencing the Operation of Anion Exchange Resins, by *F. X. McGarvey* and *J. Thompson*, Rohm & Haas Co., Philadelphia, Pa.

Characteristics of Mixed Bed and Two-Step Ion Exchangers, by *M. E. Gilwood* and *C. Calmon*, The Permutit Co., New York

The Air-to-Air Residential Heat Pump, by *G. L. Biehn*, Westinghouse Electric Corp., Boston, Mass.

Commercial Year-Round Air Conditioning With the Heat Pump, by *Philip Sporn* and *E. R. Ambrose*, American Gas and Electric Service Corp., New York

Use of Carrier Spectrum, by *T. A. Cramer*, General Electric Co., Schenectady, N. Y.

Survey of Power-Plant Electronics and Resulting Maintenance, by *Harold Garton*, Commonwealth Edison Co., Chicago, Ill.

Combustion in Gas Turbines, by *H. R. Hazard*, Battelle Memorial Institute, Columbus, Ohio

Corrosion Aspects of Bunker C Combustion in Gas Turbines, by *B. O. Buckland* and *G. M. Gardiner*, General Electric Co., Schenectady, N. Y.

Symposium on Gas Turbines

A Regenerative Gas-Turbine Generator for Central-Station Service, by *H. C. Davis*, Texas Power & Light Company, and *B. O. Buckland*, General Electric Co., Schenectady, N. Y.

Development and Application of Gas Turbines for the Oil and Gas Industry, by *T. P. Latimer* and *J. K. Hubbard*, Clark Brothers Co., Olean, N. Y.

Turbojet Aircraft Engines, by *Dimitrius Gerdan*, General Motors Corp., Indianapolis, Ind.

Economics, the Key to Evaporation Versus Demineralization for Makeup in High-Pressure Steam-Power Plants, by *E. B. Morris* and *C. E. Bruno*, American Gas and Electric Corp., New York

Evaporation for Treatment of Makeup, by *A. M. Impagliazzo*, Griscom-Russell Co., Massilon, Ohio

Performance of a Complete Demineralization Process for High-Pressure Boiler Makeup Water, by *A. B. Sisson*, Public Service Co. of Northern Illinois, Chicago, Ill.

Symposium on Network Analyzers

G. W. Bills, Bonneville Power Administration, Portland, Ore.
W. B. Boast, Iowa State College, Ames, Iowa
R. D. Goodrich, Bureau of Reclamation, Denver, Colo.
L. M. Haupt, Texas A & M College, College Station, Texas
J. B. Ward, Purdue University, Lafayette, Ind.
G. P. Wilson, Jackson & Moreland, Engineers, Boston, Mass.

ASME Applied Mechanics Eastern Conference to Feature Symposium on Computers

THE Applied Mechanics Division of The American Society of Mechanical Engineers will hold a one day symposium on Digital and Analog Computers and Computing Methods.

The symposium will be held on June 19 in Minneapolis at the University of Minnesota, in conjunction with the annual Eastern Applied Mechanics Conference of the Division, scheduled for June 18–20. It will be featured by invited papers to be delivered by authorities in the field. There will be panel discussions concerned with the present status of high-speed computing apparatus and its sphere of usefulness in scientific and industrial applications.

For further information about the symposium or its proceedings, write directly to the chairman, Prof. Lawrence E. Goodman, Talbot Laboratory, University of Illinois, Urbana, Ill.

Brookhaven National Laboratory Holds High-Energy Accelerator Conference

THE high-energy accelerator conference held on Dec. 16–17, 1952, in conjunction with the dedication ceremonies of the Cosmotron at Brookhaven National Laboratory, Upton, N. Y., was attended by over 100 scientists including many visitors from European, Canadian, and Mexican laboratories as well as representatives from the major accelerator centers of the United States.

The sessions of the first day were devoted, in the main, to descriptions of existing machines and proposed modifications to these. The talks were grouped according to machine species: frequency-modulated cyclotrons and linear accelerators were discussed in the morning and synchrotrons, both proton and electron, in the afternoon. Discussions on the second day were concerned chiefly with the new alternating-field-gradient type of machine, both of the circular synchrotron and linear accelerator variety. The present state of the theory was presented together with some discussion of the difficulties recently realized in connection with inhomogeneities in the magnetic field. This was followed by several design proposals both of a general nature and for specific-energy values. At the end of the meeting, members visited the Cosmotron for a demonstration of this machine in operation at 2 Bev.

Unity Within the Engineering Profession Expanded

UNIFICATION of the many societies in the engineering profession in one authoritative body—for which there has been a great need—came closer to reality today when it was announced by R. J. S. Pigott, past-president and Fellow ASME, newly elected president of the Engineers Joint Council, that The Society of Naval Architects and Marine Engineers and the American Society of Engineering Education became organizational members of Engineers Joint Council.

The Council, which already represents the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the American Institute of Chemical Engineers, announced their new roster after a series of meetings out of which also came the election of the new officers.

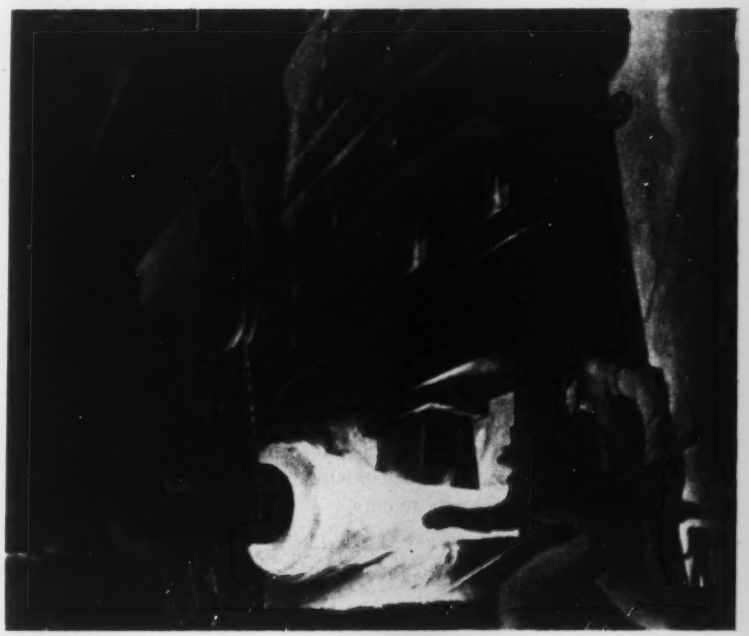
Now representing about 160,000 engineers through their constituent societies throughout the country, Mr. Pigott declared that EJC should soon realize even greater unity in the engineering world during the coming year as a result of invitations extended to several other major engineering societies.

Continuing advances toward unity is vital, Mr. Pigott asserted, "To further advance the general welfare of mankind through the available resources and the creative ability of the engineering profession."

"In this age of vast technological development, with the engineer as the motive force, the need for closely co-ordinated activities within the engineering profession becomes highly essential." He emphasized, "There has long been a need for an organ of expression on public problems and questions for professional engineers." "EJC," he continued, "views unity within the engineering profession as necessary to permit the profession to make its maximum contribution to the public welfare."

ASME Membership as of Jan. 30, 1953

Honorary Members	52
Fellows	382
Members	13,654
Associates	355
Juniors (33 and over)	3,166
Juniors (30-32)	1,880
Juniors (to the age of 29)	18,966
Total	38 455



METAL AT WORK

(The Gigantic Squeeze Play, one of the 13 original paintings by Gustav Rehberger, well-known American artist, depicts an experience of one of the seven divisions of Continental Copper & Steel Industries, Inc. It shows how machines used to forge heavy steel ingots need special alloy steels, produced by Braeburn Alloy Steel Division, to withstand the pressure of 14,000 tons produced in the press. It was first exhibited at the Hampshire House, January 21, and is being reproduced in a two-year calendar. This series of paintings is regarded as an important interpretation of the human side of the American industry.)

The President's Page

America's Urgent Need for Modern Industrial Exhibit Facilities

IN last month's MECHANICAL ENGINEERING, I made reference to the great industrial expositions which were held during late summer and early autumn in Germany, England, and Italy.

One of the most notable features of the exhibits, especially those at Hannover and London, was the extent and character of the exhibit halls and grounds in which the shows were staged. These have no parallel in this country.

West Germany, determined to make Hannover the logical successor to Leipzig as the recognized locale for commercial and industrial fairs, has created an exhibition ground fifteen minutes by taxi from the center of the city, comprising several acres of land, nine buildings of the most modern character, and over 700,000 square feet of exhibition space. Every possible facility is available for the expeditious handling of even the heaviest equipment, in and out. At the Continental Machine Tool Exhibition, there were no less than twelve separate restaurants in operation to handle the capacity crowds. Tramways and buses provided direct access to the grounds, and a vast parking lot was available.

Olympia, which is London's counterpart, is less spacious, but hardly less impressive. Housed in a single great building on Knightsbridge near the very heart of London, its galleries, as well as its main halls, are designed to take heavy floor loads. Within or immediately adjacent to Olympia are railroad sidings with loading docks, a station of the London Underground rapid transit, several restaurants and meeting halls, and a large and completely modern ramp-type parking garage.

Even Italy possesses, in the great Turin exhibition hall with a wholly unobstructed main floor area in excess of 165,000 square feet, exhibition facilities which are superior in many respects to anything we have in this country.

It is shocking that the United States, the world's greatest industrial nation, possesses no facilities for industrial exhibits which begin to parallel either of these. In the coming struggle for our share of the world's business, this defect should be remedied.

New York would be an ideal locale for a permanent fairground comparable to that of Hannover. So would Chicago and Detroit.

Certain groups in this country are already studying the possibility of developing interest in financing and constructing such an exhibition space, either among hotelkeepers and others who might benefit by the crowds which public exhibits attract, or perhaps among municipal, state, or federal governments.

Engineers have what the actuaries would call an insurable interest in such a venture, for there is perhaps no greater stimulus to engineering development and constructive redesign of product than a periodic industrial exhibition. Any sound program for the establishment of a great exhibition center within our borders deserves support, especially from a profession such as ours, to which industrial exhibitions are largely directed.

FREDERICK S. BLACKALL, JR., *President*
The American Society of Mechanical Engineers

ASME Management Division Offers Interesting Program for First Annual Meeting

Meeting to Be Held in Detroit, Mich., April 15–16

HOW to Administer Engineering Activities is the theme of the first annual Engineering Management Conference sponsored by the Management Division of The American Society of Mechanical Engineers, to be held at the Rackham Building, Detroit, Mich., April 15–16, 1953.

The program, prepared under the direction of Arthur M. Perrin, chairman of the Executive Committee of the Management Division and Ercole Rosa, Jr., secretary, has been carefully developed to give intensive coverage to those problems of engineering administration that are currently plaguing the engineering executive.

The technical program is designed to interest all levels of engineers from those in top management to those who are project leaders and group leaders. The four technical sessions which make up the program will take up such topics for discussion as top-management co-ordination of engineering departments, facilities for effective engineering, recruiting, placing and training engineers, and engineering supervision. One paper will present suggestions for the engineer concerned with developing himself for executive responsibilities. Another will discuss the new Bell Laboratories' research and engineering facilities at Murray Hill, N. J. The papers will be preprinted and available before the meeting to provide the opportunity for adequate discussion periods at each of the technical sessions.

Because of the national shortage of engineers the conference takes on added significance for it is planned to present a "how-to" program indicating the way well-respected companies are achieving effective utilization of their engineering talent.

The Rackham Building is widely recognized for its excellent meeting and banquet facilities. It will provide adequate facilities for the large number of engineering executives who are expected to attend the conference. The registration fee (to cover the cost of preprints) will be $2.50 for members and $5 for nonmembers. The total cost for members (including the papers, two luncheons, and the dinner) will be $10.50. Arrangements for sleeping accommodations have been made with the Hotel Statler in Detroit.

Carrying out a policy adopted recently by ASME, Frederick S. Blackall, jr., president of The American Society of Mechanical Engineers, will make one of his few appearances before the local sections when he presents the dinner address on Wednesday evening, April 15, on some phase of engineering management.

TENTATIVE PROGRAM

WEDNESDAY, APRIL 15

Morning, Session 1

The Executive's Responsibility to Stimulate Research and Product Development, by *C. A. Wiken*, Rockwell Manufacturing Co., Pittsburgh, Pa.

Top-Management Co-Ordination of Engineering Activities, by *W. L. Cisler*, The Detroit Edison Company, Detroit, Mich.

Afternoon, Session 2

Physical Facilities for Effective Engineering, by *M. J. Kelly*, Bell Telephone Laboratories, New York, N. Y.

Controlling Progress on Engineering Projects, by *C. C. Winsten*, Ernst and Ernst, New York, N. Y.

Extending Engineering Skills With Modern Digital Computers, by *Allen Keller*, General Electric Co., Lynn, Mass.

Evening

Dinner

Speaker: F. S. Blackall, jr., president, ASME

THURSDAY, APRIL 16

Morning, Session 3

Recruiting and Placing Engineers, by *John Gammell*, Allis-Chalmers Corp., Milwaukee, Wis.

Integrating the Engineer Into the Engineering Department, by *John Whitmore*, Airborne Instruments Laboratories, Garden City, N. Y.

Developing Engineers Into Executives, by *R. F. Pearse*, Harold F. Howard Co., Detroit, Mich.

Afternoon, Session 4

Intangible Factors in Engineering Management, by *C. A. Buller*, Diamond Alkali Co., Painesville, Ohio

What Management Expects From the Engineer, by *H. B. Riehl*, Proctor and Schwartz, Inc., Philadelphia, Pa.

How Effective Is Current Engineering Supervision? by *F. R. Benedict*, Westinghouse Electric Corp., Pittsburgh, Pa.

ASME Tours

To Los Angeles, June 12–28
From Los Angeles, July 3–23

BY making your *reservation now* you will be assured preferred space. Cancellation can be arranged later if necessary. Both tours are unusually attractive and provide de luxe arrangements. Full details on request—see page 175 of the February issue of MECHANICAL ENGINEERING—or write ASME Headquarters, Ernest Hartford, Tour Director, 29 West 39th Street, New York 18, N. Y.

SAE Paper Presented by Television

MEMBERS of the Society of Automotive Engineers attending the annual meeting in Detroit in January, witnessed for the first time a paper presented by television—a demonstration of unique driving-axle testing equipment recently placed in operation by The Timken-Detroit Axle Company.

At a special meeting held at Rackham Educational Memorial, a capacity audience of almost 1000 saw a closed-circuit television presentation on a theater-size screen demonstrating

CEREMONY MARKS FIFTIETH ANNIVERSARY OF AIR CONDITIONING

(Commemorating the Golden Anniversary of air conditioning, as developed in 1902 by the late Willis H. Carrier, Hon. Mem. ASME, a plaque citing Thomas A. Edison, Inc., as a pioneer in using air conditioning for industrial purposes, was presented to George E. Stringfellow, *left*, vice-president and director of the Edison Company, by Herbert Peacock, head of the Carrier Corporation's eastern sales division. The citation honored the Edison Company for having scored industry "firsts" in the use of air conditioning in motion pictures, in 1911, and in phonograph-records building. The Willis Haviland Carrier plaque was presented in the Museum of the Thomas Alva Edison Foundation in front of a bust of Thomas A. Edison.)

how this new equipment permits tests on driving axles never before possible in a laboratory.

The equipment, which enables Timken-Detroit to duplicate outdoor proving-ground tests indoors, is installed in the Alden Indoor Proving Ground at the company's main Detroit plant.

The testing equipment includes the most powerful dynamometers ever used for such a purpose and a new, extremely sensitive electronic control. It was conceived by Timken-Detroit engineers and designed and built by the General Electric Company. It provides the means of producing in a laboratory the torques and speeds of a vehicle as they would be actually encountered on the road and has the ability of repeating these tests accurately time after time. It also makes possible shock-loading tests which have hitherto been considered impossible.

The exclusive, closed-circuit telecast, with its large-screen reception, was handled by a TV unit of the RCA Victor Division of Radio Corporation of America. Two cameras were used at the laboratory to bring the program by microwave to Rackham Memorial.

ASME Regional Student Conferences Scheduled for 1953

Twelve Conferences to Be Held During March May

DURING the months of March, April, and May, the members of the 135 student branches of The American Society of Mechanical Engineers will convene at 12 Regional Student Conferences, which are held annually to select the regional winners of the prize papers. The papers entered in the competition are those which were selected in local papers meetings.

Last year more than 1700 student members attended the conferences. Their interest in the meetings, enthusiastic participation at the sessions, and the wholehearted manner in which they joined their fellows in pursuit of fun helped them to enjoy the meetings. The host schools made well-rewarded efforts to provide speakers from the profession and industrial. The visitors were afforded real opportunities to discuss their problems in open forum—thus to learn from leaders in the field how these problems might be met in actual practice.

Arrangements are made to have the conferences in as centrally located a college or university as possible to minimize the travel distance and to insure maximum attendance. In the east the regions are geographically small and one conference is generally sufficient. In the west, however, where the regional divisions are vaster, two or three conferences are required. The student conferences are intended to be the climax of the scholastic student-branch year. However, as many meetings as possible are planned to run concurrently with a regular ASME meeting. This year the student branches of Regions IV, VIII, and V will be held at the same time as the Regional Administrative Committee Meeting, in Gainsville, Fla.; the Annual Regional Meeting, in New Orleans, La.; and the ASME Spring Meeting, in Columbus, Ohio. A list of the student conferences is printed elsewhere on this page.

The program for the student conferences is similar to that of Society national meetings. The registration period is followed by technical sessions, at which time the papers are presented, luncheons, and dinners complete these enjoyable and educational events. The local industries in co-operation with the host branch and the ASME Section, often arrange inspection trips to plants.

The Society, in part, defrays the travel expenses from the student branch to the conference and further encourages keen competition by granting each conference $100 in prize money. The Old Guard of the Society also contributes $10 as a prize to each conference.

ASME Calendar of Coming Events

April 15–16
ASME Management Conference, Rackham Memorial Building, Detroit, Mich.
(Final date for submitting papers was Dec. 1, 1952)

April 28–30
ASME Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio
(Final date for submitting papers was Dec. 1, 1952)

May 24–28
ASME Oil and Gas Power Division Conference, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers was Jan. 1, 1953)

June 18–20
ASME Applied Mechanics Conference, University of Minnesota, Minneapolis, Minn.
(Final date for submitting papers was Feb. 1, 1953)

June 28–July 2
ASME Semi-Annual Meeting, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers was Feb. 1, 1953)

Sept. 21–25
ASME Industrial Instruments and Regulators Division and Instrument Society of American Exhibit and Joint Conference, Chicago, Ill.
(Final date for submitting papers—May 1, 1953)

Sept. 28–30
ASME Petroleum Mechanical-Engineering Conference, Rice Hotel, Houston, Texas
(Final date for submitting papers—May 1, 1953)

Oct. 5–7
ASME Fall Meeting, Hotel Sheraton, Rochester, N. Y.
(Final date for submitting papers—July 1, 1953)

Oct. 29–30
ASME Fuels Division and AIME Coal Division Joint Conference, Conrad Hilton Hotel, Chicago, Ill.
(Final date for submitting papers—June 1, 1953)

Nov. 29–Dec. 4.
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1953)
(For Meetings of Other Societies, see page 261)

1953 ASME Regional Student Conferences

	Region	*Host*	*Place*	*Date*
I	New England	University of New Hampshire	Durham, N. H.	April 24–25
II	Eastern	College of the City of New York	New York, N. Y.	April 18
III	Alleghenies	Princeton University	Princeton, N. J.	April 17–18
IV	Southern	University of Florida (Concurrent with Regional Administrative Committee Meeting)	Gainesville, Fla.	March 29–30
V	Midwest	Ohio State University (Concurrent with ASME Spring Meeting)	Columbus, Ohio	April 27–28
VI	Northern Tier	Iowa State College	Ames, Iowa	May 5–6
VI	Southern Tier	Washington University	St. Louis, Mo.	April 23–24
VII	Pacific Northwest	University of Washington	Seattle, Wash.	April 30–May 2
VII	Pacific Southwest	University of Utah	Salt Lake City, Utah	May 15–16
VIII	Northern Tier	University of Nebraska	Lincoln, Neb.	April 20–21
VIII	Rocky Mountain Tier	Colorado A&M College	Fort Collins, Colo.	April 24
VIII	Southern Tier	Tulane University of Louisiana (Concurrently with Annual Regional Meeting)	New Orleans, La.	April 13–14

MRI Meeting on Automatic Computers Draws Large Attendance

AUTOMATIC computers are fostering a new concept in engineering thought Rex Rice, Northrop Aircraft, Inc., Hawthorne, Calif., told some 200 technical and management personnel from the United States and Canada who attended the two-day symposium on automatic computing equipment sponsored by Midwest Research Institute, Kansas City, Mo., January 8 and 9. Speaking during a panel discussion at the meeting, Mr. Rice stressed this new trend as one of the major gains from the use of automatic computing equipment.

A major U. S. airline presented a problem to the meeting involving application of computer principles. This particular project calls for consolidation, recording, and distribution of such varied information as crew flight time, traffic loads, mechanical performance, costs, arrivals, and departures, and the like. It was pointed out that this task is within the scope of existing machines, but that the crux of the problem lies in development of satisfactory methods for programming this information for the computers.

The internal engineering aspects of the CPC equipment were described by S. L. Lida and E. C. Kubie, both of International Business Machines, New York, N. Y., in connection with questions regarding the self-checking capabilities of this apparatus. Linn Helander, Fellow ASME, head of the department of mechanical engineering, Kansas State College, presided.

The need for computers in industry is frequently determined by the complexity of the problems to be solved. R. J. Medkeff, Askania Regulator Company, Chicago, Ill., mentioned that even a one-man consulting engineering firm could profitably apply a computer if problems were of sufficient technical complexity.

The panel devoted part of the session to exploration of the educational requirements for those who would work with computers. Grace Hopper, systems engineer for Remington-Rand, Inc., said that engineers ought to learn about the calculator as well as the slide rule. She also proposed more courses in numerical methods, adding that some of the classical mathematics courses may have to be revised.

It was further suggested that more professors resort to the "analog method" of teaching science, relating a course in chemistry, for example, to a prior course in engineering, showing how the two compare in certain respects.

Complete proceedings of this meeting will be available shortly to technical personnel at $4 a copy. Requests should be addressed to Midwest Research Institute, 4049 Pennsylvania, Kansas City, Mo.

Cooper Union Faces Problem of Hiring Teachers

Engineering Students Earning More Than Teachers

EVENING students at the Cooper Union School of Engineering are earning so much it is becoming difficult to attract qualified men to teach them, according to Edwin S. Burdell president.

Average earning for the evening engineering students is $4214 annually, 8 per cent above the average a year ago and 30 per cent above the average two years ago, Dr. Burdell said.

He based his report on a survey of students just above the first year, which has just been completed by Prof. Herbert F. Roemmele, Mem. ASME, dean of students. A similar survey a year ago showed average evening-student earnings to be $3924. Two years ago the evening-student earnings averaged $3240, nearly a thousand dollars a year less than today.

Mechanical-engineering students earn most ($4524 average) with civil-engineering students next ($4116), followed by electrical-engineering students ($3972) and chemical-engineering students ($3876).

While expressing pleasure at the high earnings of his evening students, Dr. Burdell pointed out the huge problem which engineering schools in particular face in attracting talented teachers and holding them in the face of high wages paid to engineers by industry.

"Dean Roemmele's survey showed that individual evening undergraduates were earning as much as $7800 a year," Dr. Burdell said. "It is no secret that this is considerably more than most engineering instructors are paid for teaching these young men. Indeed, it approaches closely the maximum salary paid teachers in most colleges.

"Without suggesting in any way that industry should begin to deflate engineering salaries, I do believe that industrial leaders should realize that their material inducements are draining away competent instructors and may, in the near future, aggravate the present shortage of engineers by curtailing our facilities for training through lack of teaching personnel.

"A forthright attack on this problem by leaders in both education and industry is long overdue. What the solution will be I cannot, of course, predict. Perhaps industry may find it advantageous to return to the colleges on a dollar-a-year or lend-lease basis some of the especially talented teachers they have lured away in recent years," Dr. Burdell said.

The Cooper Union has been a pioneer in evening engineering education. Its courses were established in 1859 by Peter Cooper, inventor, ironmaster, and philanthropist. Admission to the School of Engineering, which continues the free-tuition policy established by its founder, is by competitive examination.

Meetings of Other Societies

March 15–19
American Chemical Society, 123rd national meeting, Biltmore and Statler hotels, Los Angeles, Calif.

March 15–19
American Institute of Mining and Metallurgical engineers, annual joint meeting of petroleum, metals, and mining branches, Statler Hotel, Los Angeles, Calif.

March 16–20
National Association of Corrosion Engineers, conference and exhibition, Hotel Sherman, Chicago, Ill.

March 17–20
American Society of Tool Engineers, 21st annual meeting, Hotel Statler, Detroit, Mich.

March 19–21
Optical Society of America, spring meeting, Hotel Statler, New York, N. Y.

March 23–27
American Society for Metal in co-operation with western division of 20 national technical societies, eighth Western Metal Congress and Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.

March 24–27
Greater New York Safety Council, 23rd annual safety convention and exposition, Hotel Statler, New York, N. Y.

March 25–27
Pressed Metal Institute, fourth annual spring technical meeting, Hotel Carter, Cleveland, Ohio.

March 25–27
American Power Conference, annual meeting, Hotel Sherman, Chicago, Ill.

March 25–27
Society of Automotive Engineers, national production meeting, Hotel Statler, Cleveland, Ohio.

March 31–April 2
International Magnesium Exposition, National Guard Armory, Washington, D. C.

April 8–10
American Petroleum Institute, eastern district spring meeting, Hotel William Penn, Pittsburgh, Pa.

April 10–11
Michigan Engineering Society, annual meeting, Kellogg Center Hotel, Michigan State College Campus, East Lansing, Mich.

April 13–15
American Society of Lubrication Engineers, annual meeting and exhibit, Hotel Statler, Boston, Mass.

April 13–15
Canadian Institute of Mining and Metallurgy, annual general meeting, The Macdonald, Edmonton, Alt., Can.

April 26–May 5
Hannover Technical Fair, Hannover, Germany

(ASME Calendar of Coming Events, see page 260)

Mexican Prisoner Writes Again

THE Mexican "prisoner-swindle" letter which makes the rounds from time to time, has cropped up once more. Such a letter was received quite recently. The writer describes himself as a prisoner in Mexico sentenced for bankruptcy. However, he has the sum of $450,000 in a United States Customhouse and one third of this money is promised in exchange for helping the man in his present predicament. From there on the story is a plea for assistance giving instructions for the recovery of suitcases, baggage claim checks, and the trunk in which the money is contained.

We suggest, in such a case, that you let the U. S. Postal Authorities handle the matter.

ASME Elects Eight Fellows

THE American Society of Mechanical Engineers has honored eight of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer who has acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and has been a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men whose outstanding contributions to their profession and to the Society were so honored are:

Oliver Edward Barthel

OLIVER E. BARTHEL, consulting engineer, Detroit, Mich., since 1906, has made many significant engineering contributions in the automotive field. His first contact with it was in 1896 when he was employed by Charles B. King, where he was instrumental in the creation of the first automobile to run on the streets of Detroit. Later in 1901 he was employed by Henry Ford for whom he designed and supervised the building and testing of the first Ford racing car that Henry Ford drove in defeating Alexander at the Grosse Pointe race track in September, 1901. Mr. Barthel designed the first outboard motor in 1906. He also originated, designed, and built in 1912 the first streamlined automobile and invented and developed the taper automobile frame which made streamline design possible. He was the first to produce a car with instrument board and concealed dashboard, and in 1917 designed and built the first all-steel automobile body. He has designed engines and other essential automobile units for David Buick, Byron J. Carter, John D. Maxwell, A. R. Welch, and other well-known automobile pioneers and manufacturers. Mr. Barthel was a design engineer in the Henry Ford Company, later Cadillac Automobile Company in 1901. He worked in the experimental departments of Ford Motor Company, 1903–1904; Olds Motor Works, 1904–1905; and Holley Carburetor Company, 1906. Since 1904 there have been 36 U. S. patents issued to him covering internal-combustion engines, automobiles and accessories, steam boilers, oil burners, a monorail elevated-railway system, laundry machinery, variable-pitch airplane propellers, peat-fuel briquetting compressor, and other allied inventions. In 1938 he designed and produced a cold color lamp for the treatment of several diseases, both mental and physical, that has proved highly successful in clearing up many heretofore difficult cases. He has also designed, invented, and developed an artificial denture articulator that overcomes all the usual difficulties encountered by the dental profession in the making of artificial dentures and insures perfect centric occlusion with proper leverage that orthodox dental technique does not provide.

Maurice Walter Carty

MAURICE W. CARTY, mechanical engineer, Stone and Webster Engineering Corporation, Boston, Mass., has made a distinct contribution to the science of engineering in the wide application of engineering principles to attain better economies together with the broadening of the area in which scientific knowledge has been applied in a practical manner. With his present company since 1906, Mr. Carty has had charge of the engineering and design of numerous power-station jobs. He was the supervisory engineer on the 385,000-hp Conowingo hydroelectric development for the Susquehanna Power Company and supervised the design of the 322,500-kw Moss Landing steam-electric plant at Moss Landing, Calif. His work includes the 215,000-kw steam-electric plant, San Francisco, Calif., the 180,000-kw Potomac River plant, the 170,000-kw Kern plant, Bakersfield, Calif., and many others. The many projects for which he was responsible include power stations covering a broad range of technical advance not only in magnitude of project but also in station arrangement and improved economics to fit widely divergent natural conditions. Mr. Carty has also made many economic reports and appraisals including a report on the fuel situation of the Republic of Cuba for the United States Department of State, a report on steam-electric power plants for Rio de Janeiro for the Brazilian Traction Power and Light Company, Ltd., investigation of electric-power supply at Rockford, Ill., for Central Illinois Electric and Gas Company, and a report on the diesel-engine business for Busch-Sulzer Brothers, Diesel Engine Company. He has had several articles published in the technical press.

Wilfrid Estill Johnson

WILFRID E. JOHNSON, general manager, Nucleonics Division, General Electric Company, Richland, Wash., has had a distinguished record in analysis and design of engineering equipment and in management of extensive undertakings. As a design engineer at General Electric from 1930 to 1940, he completed the development of the first hermetically-sealed refrigerating compressor using an integral horsepower motor and other innovations in the compressor field. During World War II he directed a G-E organization which converted laboratory-developed superchargers to a high production status; successfully co-ordinated design and engineering work at five different production plants; and supervised design and development of a highly successful new supercharger for the P-47 pursuit plane. Later he set up and was in charge of an organization which undertook production engineering for the J-type jet engines. After World War II he set up an engineering organization for the postwar program of the air-conditioning department and aided in product development. Since 1948 he has been with G-E's Nucleonics Division at Richland, aiding in design and construction of nuclear reactors. Mr. Johnson was in charge of the planning and administration of Richland's second postwar $150 million design and construction program. His present position at Richland involves helping to run a $50-million-a-year operation employing about 9000 people. Active in ASME affairs, Mr. Johnson helped to establish the ASME Fort Wayne Section and was a member of Power Test Code Committee on Centrifugal Blowers. He is the author of several papers and has had 12 patents issued to him.

S. Logan Kerr

S. LOGAN KERR, consulting engineer, president, S. Logan Kerr & Co., Inc., Flourtown, Pa., and vice-president and general manager, Lyophile-Cryochem Corp., Baltimore, Md., is widely known for his work as a hydraulic engineer, particularly in fields of water power, public water supply, pumping, water hammer, and surge control. During his early career he developed an automatic frequency and load-control system for hydroelectric plants and electric generating systems. Later he aided in the solution of water-hammer problems in motor-driven water-works pumping systems including the Groton Lake Pumping Plant for New York City, the City of Toledo, Ohio, St. Louis County Water Company, and many others. In 1935 he joined the U. S. Engineer office and was in charge of the mechanical section of the Passamaquoddy Tidal Power Project, Eastport, Me. From 1937 to 1945 he was with United Engineers & Constructors, Inc., in various capacities, including the design of chemical plants, circulating-water systems for steel mills and utility plants, and similar important assignments, including four years as Washington representative of the company. Since 1945 he has been in private consulting practice working on a number of projects in various fields. He has had many papers published and holds numerous patents. Active in ASME affairs, he is presently chairman, Committee on Power Test Codes No. 18 for Hydraulic Prime Movers; a member of the Hydraulic Division Executive Committee of which he was chairman in 1936–1938; organizer and chairman since 1931 of Committee on Water Hammer; member Power Test Code Committee on Speed Governors; member Standing Committee on Power Test Codes; former chairman, ASME Committee on Consulting Practice; chairman, Technical Committee 4 on Hydraulic Turbines; International Electrotechnical Committee; ASME representative, Construction Industry Advisory Committee; Federal Works Association; and many other similar assignments. Mr. Kerr was awarded the ASME Junior Prize in 1921.

Emmart La Crosse

EMMART LA CROSSE, director of engineering, Stone and Webster Engineering Corporation, Boston, Mass., has a long outstanding record of achievement in the engineering field. He has been the directing genius of a great many major engineering projects, especially during World War II. Under his direction as engineering manager, Stone and Webster engineers worked on some of the largest ordnance and explosives plants ever built and furnished important consulting services to organizations in similar work. His staff played a major part in the synthetic-rubber program and other projects during this period. Simultaneously, Mr. La Crosse directed the design of steel foundries, brass mills, machine and forge shops, a shipyard, navy-yard extensions,

synthetic ammonia, nitric acid, and ethylene plants, food products and pharmaceutical plants, factories manufacturing shell cases, bomb sights, and other optical instruments, and several large industrial water-supply systems and steam-electric power plants. His outstanding contribution to World War II was the direction of Stone and Webster's engineering work for the atomic bomb project. His staff designed and placed in successful operation the University of Chicago's pilot plant which was the basis of the plutonium process later developed. His staff also was responsible for the engineering design for the electromagnetic process, developed in a huge scale at Oak Ridge, Tenn. This multimillion-dollar plant was the first to produce fissionable material in quantities adequate for experiments on explosive properties and for the development of bomb designs. He also directed designs for the City of Oak Ridge and for the heavy hydrogen plant at Trail, British Columbia. His postwar work has included supervision of more than 5,000,000 kw of steam, hydro, and diesel-electric power generation, natural-gas lines, and manufacturing plants of many kinds.

John Moyes Lessells

JOHN M. LESSELLS, associate professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass., and president, Lessells and Associates, Boston, Mass., has made outstanding contributions to the development of applied mechanics. With such leaders as Timoshenko and Kimball, he set a pattern for the applied-mechanics development in the ASME which in later years brought the United States to the top in this field.

He is one of the small group who founded the ASME Applied Mechanics Division and one of its chief supporters. To his credit, in particular, is the high standing of the *Journal of Applied Mechanics* which he has served as editor since it was instituted. From 1920 to 1930 Professor Lessells worked for Westinghouse Electric Corporation where he organized the Mechanics Division of the Research Laboratories. Under his direction valuable mechanics research was carried on, with many publications resulting from the work. In 1931, as manager of engineering at Westinghouse's Steam Turbine and Diesel Engine Works, he helped to initiate new methods of design and research, bringing a higher technology to bear on steam-turbine development which has borne fruit in later years. Since 1936 he has successfully divided his interests between teaching and consulting activities, and in 1946 formed a research and development company, Lessells and Associates. Professor Lessells has been chairman, ASME Applied Mechanics Division, and is a member, *Applied Mechanics Reviews* Managing Committee. With S. Timoshenko, he is the author of a book "Applied Elasticity," and has had many papers published.

Edwin Burnley Powell

EDWIN B. POWELL, consulting engineer, Stone and Webster Engineering Corporation, Boston, Mass., has earned a nationwide reputation for the application of the most advanced science, particularly chemistry and metallurgy, to the solution of practical problems in the power-generating field. An engineer's engineer, Mr. Powell is believed to be the most widely consulted engineer in the public-utility field. When he joined Stone and Webster in 1907, he introduced systematized methods of operation and maintenance in a large number of power and traction companies then under the company's management. He also designed with the collaboration of W. J. Santmyer the first pulverized coal-fired boiler plant installed by any American public utility. A consulting engineer since 1920, his investigations have included every phase of power generation. He is especially recognized as an authority on water treatment, corrosion of piping and condenser tubes, refractories, furnaces and boiler-setting construction, combustion of fuels, alloy steels for high-temperature service, mussel control in condenser circulating-water conduits, and silica control. His water-treating installation at Baton Rouge, La., which conditions 2,500,000 lb per hour of raw Mississippi River water for use in high-pressure boilers, is probably the largest and most difficult job of its kind ever undertaken. Mr. Powell's work on the conditioning of water for the famous Montaup boiler is equally well known.

He has been very active in Society affairs especially on Boiler and Power Test Codes Committees. He is the author of several papers presented before ASME and other engineering societies.

James C. White

JAMES C. WHITE, president and general manager, Tennessee Eastman Company, Kingsport, Tenn., and president, Texas Eastman Company, Longview, Texas, both divisions of Eastman Kodak Company, has spent 30 years in responsible charge of design and construction of one of the largest manufacturing plants in the South. He helped Tennessee Eastman grow from a small plant in 1920 into one of the world's largest producers of cellulose-acetate yarn and cellulose-acetate plastics, and an important producer of other chemicals.

While directing the Kingsport engineering organization, he has made many personal contributions to the design of buildings and production equipment of the plant. His detailed knowledge of powerhouse equipment has been invaluable in the expansion of the power plant, one of the largest industrial power plants in Tenn. In addition, Mr. White directed engineering and design of the manufacturing buildings and equipment of the government-owned high-explosives plant at Kingsport for producing RDX. From 1943 to 1946 he directed the operation of Clinton Engineer Works-TEC, Oak Ridge, Tenn., a government-owned plant for the separation of U-235, making many personal contributions to design of equipment and plant. Since 1945 he has had complete charge of Eastman operations at Kingsport including the engineering and construction required for postwar expansion and for a large chemical plant at Longview, Texas. Mr. White is also the president of Holston Defense Corporation, Kingsport, Tenn. He holds three patents.

People

J. HENRY RUSTON, Mem. ASME, director of the department of chemical engineering at Illinois Institute of Technology, was the seventeenth recipient of the Walker Award for outstanding achievement in his field, at the forty-fifty annual meeting of the AIChE, held in Cleveland, Ohio.

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FRANK J. HANRAHAN, Mem. ASME, has been appointed permanent executive vice-president of the American Institute of Timber Construction. He is past-chairman, Washington, D. C. Section, ASME; past-chairman, Executive Committee, Wood Industries Division; and member, ASME Constitution and By-Laws Committee.

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LEROY A. VAN BOMEL, Mem. ASME, chairman of the board of the National Dairy Products Corporation, has been named a member of a newly created Board for Development at the New York University. The board will help determine and implement policies in connection with the University's ten-year $102 million program for new buildings and endowment. Chairman of the group is CHARLES R. COX, president of the Kennecott Copper Corporation.

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CHARLES A. THOMAS, president, Monsanto Chemical Company, received the highest award in American industrial chemistry, the Perkin Medal of the American Section of the Society of Chemical Industry for 1953, at a dinner meeting held in New York, N. Y., Jan. 16, 1953.

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CHARLES J. MCCARTHY, vice-president of United Aircraft Corporation, has been elected president of the Institute of the Aeronautical Sciences for 1953.

The four I.A.S. vice-presidents recently elected are: George W. Brady, director of engineering, Propeller Division, Curtiss-Wright Corporation; Clarence L. (Kelly) Johnson, chief engineer, Lockheed Aircraft Corporation; James S. McDonnell, Jr., president, McDonnell Aircraft Corporation; and Ernest G. Stout, staff engineer, Consolidated Vultee Aircraft Corporation. The I.A.S. Treasurer for 1953 is Preston R. Bassett, president, Sperry Gyroscope Company, Division of The Sperry Corporation. S. Paul Johnston was re-elected director of the Institute; Robert R. Dexter was re-elected I.A.S. secretary; and Joseph J. Maitan was re-elected controller.

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VINCENT J. SCHAEFER, General Electric Research Laboratory weather scientist, received the 1952 Robert M. Losey award at the honors night dinner of the Institute of the Aeronautical Sciences held at the Hotel Astor, New York, N. Y., Jan. 26.

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DEAN R. CHAPMAN, aeronautical research scientist, Ames Aeronautical Laboratory, NACA,

was the recipient of the Lawrence Sperry Award for 1952. Also honored on this occasion were: John P. Stapp, Lieut. Col., USAF, who received the 1952 John Jeffries Award; and John Stack, assistant director, Langley Aeronautical Laboratory, NACA, who received the 1952 Sylvanus Albert Reed Award.

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HORACE G. CROCKETT, partner in the New York management-consulting firm of McKinsey & Company, was re-elected president of the Association of Consulting Management Engineers, Inc., at its recent annual meeting. Among the new officers and directors elected at the meeting are H. B. MAYNARD, Mem. ASME, as vice-president and director. ALONZO FLACK, Mem. ASME, and N. M. MITCHELL, Mem. ASME, are among the newly elected directors.

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R. C. SOGGE, manager of the standards department, Engineering Services Division, General Electric Company, Schenectady, N. Y., has been elected president of the United States National Committee (USNC) of the International Electrotechnical Commission.

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WILLIAM T. NICHOLS, director, general engineering department, Monsanto Chemical Company, St. Louis, Mo., has been elected president of the American Institute of Chemical Engineers for 1953.

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SYDNEY WILMOT, manager of technical publications and for 30 years a member of the staff, retired on Dec. 31, 1952, it was announced by the American Society of Civil Engineers, New York, N. Y. In that period, Mr. Wilmot has directed the publication of the entire written record of ASCE technical accomplishment, including "Proceedings," "Transactions," "Proceedings-Separates," Technical Manuals, Manuals of Engineering Practice. For 24 years he has been secretary of the Society's Committee on Publications.

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ERWIN H. SCHELL, Mem. ASME, received the Wallace Clark Award at the dinner meeting of the National Management Council held at the Plaza Hotel, New York, N. Y., Jan. 14, 1952.

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THOMAS H. CHILTON, Mem. ASME, technical director, engineering department of E. I. du Pont de Nemours & Co., Inc., was named chairman of the Engineering Manpower Commission of Engineers Joint Council.

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R. J. S. PIGOTT, past-president and Fellow ASME, consultant, Gulf Research and Development Company, was elected president of the Engineers Joint Council.

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T. A. MARSHALL, JR., Mem. ASME, was appointed permanent secretary of the Engineers Joint Council.

MARTIN GOLAND, Mem. ASME, editor, *Applied Mechanics Reviews*, associate director for engineering, Midwest Research Institute, was elected a Regional Councilor of the Office of Ordnance Research. He will also serve as a member of the Engineering Advisory Committee.

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E. N. McDONNELL, president of McDonnell & Miller, Inc., Chicago, Ill., was awarded the 1952 F. Paul Anderson Medal of The American Society of Heating and Ventilating Engineers at the annual banquet, January 29, held at the Conrad Hilton Hotel, Chicago, Ill.

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WILLARD F. ROCKWELL, Mem. ASME, Pittsburgh industrialist and chairman of the board of Rockwell Manufacturing Company, Standard Steel Spring Company, Timken-Detroit Axle Company, has been named a key aide in reorganization of the Mutual Security Program.

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WALTER C. OELMAN, vice-president and general manager of Standard Molding Corporation, Dayton, Ohio, has been elected president of the Society of Plastics Engineers.

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REG F. TAYLOR, consulting engineer, Houston, Texas, has been elected 1953 president of The American Society of Heating and Ventilating Engineers. Other officers elected were: First vice-president, L. N. HUNTER, Mem. ASME, vice-president of research, The National Radiator Company, Johnstown, Pa.; second vice-president, JOHN E. HAINES, vice-president, Minneapolis-Honeywell Regulator Company, Minneapolis; treasurer, JOHN W. JAMES, Mem. ASME, vice-president in charge of research, McDonnell & Miller, Inc., Chicago, Ill.

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ROBERT M. BURNS, chemical co-ordinator and director of chemical and metallurgical research, Bell Telephone Laboratories, Murray Hill, N. J., was designated to receive the 1953 Willis Rodney Whitney Award of the National Association of Corrosion Engineers. SCOTT P. EWING of the research laboratory, Carter Oil Company, Tulsa, Okla., has been named to receive the Frank Newman Speller Award. The awards will be presented during the NACE ninth annual conference and exhibition, March 16–20, to be held in Chicago, Ill.

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ELGIN B. ROBERTSON, president of Elgin B. Robertson, Inc., Dallas, Texas, has been nominated for the presidency of the American Institute of Electrical Engineers.

ASME Standards Workshop

ASME Screw-Thread Manual

NOW with the printer and possibly available by the time this issue of MECHANICAL ENGINEERING reaches subscribers, is a publication designed especially for shop and drafting-room use to be known as the ASME Screw Thread Manual. Its two main purposes are:

1 To give the substance of everything in the American Unified Standards for Screw Threads and their Gages necessary in selecting, or designing and making, and testing the threads constituting the bulk of use. These are Coarse, Fine, and 8-Thread Series of standard threads of Classes 2A and 2B from the smallest to 1 1/2 inches diameter. Tables of limits of size are confined to these threads.

2 To make possible calculating by simple arithmetic all other standard threads and gages in the ASA Standards, and all special threads of the new A and B classes, except those of abnormal diameter, pitch, or length of engagement.

Interesting and useful supplementary information are contained in its introduction and appendixes. The former discusses the virtues of screw-thread unification and the history of how it came about.

Among the particularly handy tables is one showing for each diameter what pitches of thread are available in the six series of standard threads. Draftsmen and designers find such a table so important in the selection of screws to be used in a new design that they usually compile their own when one in published form is not available. Another table gives compactly the formulas for all major, pitch, and minor diameters for the six unified classes, saving the time of locating them in the text. Still another has the inch limits of size converted to millimeters for the most-used threads, which will be useful in interpreting specifications received from or sent to countries that use the metric system.

A preliminary draft of the manual was distributed for comment and criticism to members of B1 Sectional Committee. Several made important suggestions for its improvement, others found nothing to criticize, and some made highly complimentary comments. The ASME Standardization Committee, which sponsored this manual, feels that with such co-operation in its compilation it should accomplish its purpose and be well received by the manufacturing industries.

Screw Threads

THE B1 Editorial Committee on the revision of ASA B1.1-1949 Unified and American Screw Threads, held its first meeting Dec. 11, 1952, in Washington. No major changes in the essential provisions of the present third edition of the standard are contemplated, but considerable revision of the text and its rearrangement and that of the tabular format will be undertaken. The first edition, which was the American version of the Accord achieved after years of effort at unification with British and Canadian practice, intro-

duced so much of change for industry that it was perforce written and devised to care for a transition period. Four years have passed during which some changes in specifications acceptable to the three countries were made which were incorporated in the second and third editions of ASA B1.1-1949. Most important is that experience has been acquired permitting and indicating the need now for a simpler and handier-to-use presentation of the standard's requirements. The formulas and values most likely to be affected are those for minor diameter tolerances of internal threads. Minutes of the meeting record that: "It would be desirable to bring minor diameter limits within the range of commercially available drill sizes in view of the present delayed delivery of special and metric drills." Another recognized weakness of the American Standard is its lack of definite rules for allowances for screw-thread plating or coating. The British have already published a Draft on the Plating of Unified Threads.

Coming Meetings

Instrumentation

INSTRUMENTATION for the Iron and Steel Industry will be the subject of a two-day conference sponsored by the Carnegie Institute of Technology and the Instrument Society of America to take place at the Roosevelt Hotel, Pittsburgh, Pa., on March 26–27, 1953.

The purpose of this symposium is to encourage a wider appreciation for and knowledge of instruments in this industry.

The third annual symposium on instrumentation for the iron and steel industry is directed toward the man from industry to reveal to him how he can use instruments to improve production, which is so critical at the present time.

Wallace Richards, director of the Carnegie Museum, will address the first session and open the symposium. His subject will be "Pittsburgh—the City of the Future."

Prestressed Concrete

REALIZING that recent developments and new applications of prestressed concrete have advanced rapidly during the past few years, the Newark (N. J.) College of Engineering under the sponsorship of the Portland Cement Association, will offer a series of conferences on this subject, to be held at Campbell Hall.

This series of eight conferences will consist of two weekly sessions to be given on Monday and Thursday evenings from 7:30 to 9:30 p.m. for four weeks, starting Monday, April 6, 1953. Each conference will be under the leadership of a chairman of national prominence and will feature speakers of outstanding professional attainment in this field.

This conference series should provide an excellent opportunity for engineers, architects, contractors, and manufacturers to obtain new knowledge of this rapidly developing field of engineering technology.

Communications

A SYMPOSIUM on Communications will be one of the outstanding features of a joint meeting to be held at the Royal York Hotel, Toronto, Ont., Can., April 26–29, 1953. This is the first joint conference to be sponsored by the Chemical Engineering Division of The Chemical Institute of Canada, and the American Institute of Chemical Engineers. Other items on the program will include a series of technical papers and plant tours to Toronto, Hamilton, and Niagara Falls areas.

Among the featured speakers will be C. F. Braun, Hon. Mem. ASME, president of the C. F. Braun Company, Alhambra, Calif., a company well known for its manufacture of heavy chemical equipment. Mr. Braun with his paper, "Accounting as a Means of Communications," will wind up what promises to be an outstanding symposium on communications. Other papers in this symposium will deal with the use of the written and spoken work, and semantics.

The technical papers will cover recent developments in process, design, and equipment and will be of value and interest to the Canadian and American engineers and executives who attend the sessions.

Industrial Waste

THE eighth Purdue Industrial Waste Conference is to be held in Lafayette, Ind., on May 4–6, 1953. This is a meeting where the scientists from industry and government meet to discuss mutual problems encountered in the disposal of waste materials that may result in the pollution of air or water. The conference will be held in the Purdue Memorial Union Building. Because of the large number of papers that will be presented it will be necessary to run concurrent sessions.

Efforts are made to obtain papers that describe up-to-date information on the progress being made in the disposal of industrial wastes. Historical or review papers may be presented but every effort will be made to have papers so indicated by appropriate titles. Registration is open to anyone interested in waste disposal. The fee for attendance will not exceed ten dollars.

The Proceedings for the Seventh Conference now available at $1.25 from Dean A. A. Potter, School of Engineering, Purdue University, Lafayette, Ind.

Anthracite

LATEST developments in the distribution, utilization, economic, and hygienic aspects of anthracite will be subjects for the eleventh annual Anthracite Conference set for May 7–8 at Lehigh University.

The conference, sponsored by the Anthracite Institute and Lehigh University, is designed to bring engineers, educators, operators, and retail dealers as well as the general public up to date on the technological progress in Pennsylvania's hard-coal industry.

Serving as members of the planning committee are representatives of educational institutions, research groups, anthracite operators, and retailers.

Invited speakers will include government officials, manufacturers of heating equipment, safety directors, and mining engineers.

Research

THE Operations Research Society of America will hold its annual meeting on May 15–16, 1953, at Case Institute of Technology in Cleveland, Ohio.

The program includes symposiums on: What is Operations Research? The Use of Sampling Theory in Operations Research; Linear Programming; Game Theory in Operations Research; Teaching of Operations Research; and sessions with contributed papers. An informal smoker will be held on Friday evening, May 15.

Members of the society and other interested persons are encouraged to submit papers for presentation at the meeting. Papers or requests for additional information should be sent to Prof. R. F. Rinehart, Program Committee Chairman, Case Institute of Technology, Cleveland 6, Ohio. Papers are limited to 15 minutes and abstracts of about 100 words must be provided for each paper on the program. The deadline for the acceptance of papers and their abstracts for this meeting is April 6, 1953.

Education

THE University of Michigan, college of engineering, has announced two intensive courses in automatic control. The first is scheduled for June 15–20, 1953, inclusive, and the second for June 22–25, 1953, inclusive.

The courses are built around the principles and application of measurement, communication, and control. Course 1 will consist of the fundamental in each of these fields and will include some fundamental work in nonlinear systems. Course 2 will take up applications of the fundamentals to more advanced problems. There will be four hours of lecture each morning and three hours of demonstration in the afternoon. Extensive use will be made of computing, instrumentation, and servo laboratories on the campus. The role of analog-computing methods will be emphasized.

Further information may be obtained by writing to Prof. M. H. Nichols, Room 1523 East Engineering Building, University of Michigan, Ann Arbor, Mich. April 15, 1953, is the closing date for registration.

Reactor Technology

APPLICATIONS are now being received for enrollment in the 1953–1954 session of the Oak Ridge School of Reactor Technology which begins September 14, 1953. Students with graduate or undergraduate degrees in engineering or one of the basic sciences, or who will have attained such a degree by September, 1953, and who have special interest and aptitude to engage in applied nuclear science and engineering, are invited to apply for admittance. Prospective students must be United States citizens and appointment to the school is contingent upon satisfactory completion of an Atomic Energy Commission secur-

ity investigation prior to September, 1953. Further information and application forms may be obtained from the Oak Ridge School of Reactor Technology, P. O. Box P, Oak Ridge, Tennessee.

Motion and Time Study

THE annual Motion and Time Study intensive course presented by the department of industrial engineering of Washington University at St. Louis will be presented from June 11–19, inclusive.

The material to be covered will be presented with emphasis on setting up correct methods before the job is in existence as well as procedures for the improvement of existing job methods. The objective of the course will be to prepare the student to apply motion and time study in his own organization and to train others in his company in the principles of motion and time study.

Several visiting speakers will present their experiences with the application of motion and time study and with related fields in industry to further enhance the material of the course.

For further information concerning course content, instructors, and registration write to Prof. Gerald Nadler, the Department of Industrial Engineering, Washington University, St. Louis 4, Mo.

Semiconductors

A SERIES of lectures on the general theory of semiconductors will be delivered by H. K. Henisch, of the University of Reading (England), at the Polytechnic Institute of Brooklyn under the sponsorship of Sylvania Electric Products Inc., Bayside, N. Y. Four two-hour lectures will be given by Dr. Henisch in the Student Lounge of the Polytechnic Institute, 99 Livingston Street, Brooklyn, from 8 to 10 p.m. on four successive Thursdays, April 23 and 30 and May 7 and 14. He will lecture on the general theory of semiconductors and the application and its verification in the case of germanium, silicon, selenium, lead sulphide, selenides, and tellurides.

This series of lectures on semiconductors is open without fee to all interested persons.

Industrial Electronics

A NEW course in industrial electronics for persons who work on equipment which is dependent on electron tubes, has been announced by the International Correspondence Schools of Scranton, Pa.

The new course is being designed to the needs of engineers and technicians—electrical, mechanical, civil, and chemical—who wish to take advantage of the applications of electron tubes in their own fields.

An entire section of the 46-lesson course is devoted to the installation, maintenance, and repair of electronic control equipment. Also covered are mathematics, basic electricity, radio theory, electrical calculations, chemistry and mechanics, electrical equipment, and industrial electronics. Estimated average study time required for the completion of the course is 800 hours.

Doehler Award Fund Announced

IN April of 1949, Doehler-Jarvis Corporation, a member of the American Die Casting Institute, donated $25,000 for the establishment of a perpetual trust to be known as the Annual Doehler Award Fund. The Institute was appointed trustee of the Fund.

The Award, which is to be made annually, will consist of a suitable plaque and a cash honorarium of at least $500, or more if the income of the Fund permits and at the discretion of the Award Committee.

The Award Committee consists of the Board of Directors of the Institute. The Award Committee has sole authority over the selection of the recipient and the operation of the award program.

The Award is to be made annually for the outstanding contribution to the advancement of the die-casting industry, or to the art of die casting as represented by technical achievement, advancements in plant operations, or other activities, not primarily of a scientific or operational nature that result in the enhancement of the reputation and acceptability of die castings.

Nominations for the Award and supporting papers or other material will be received annually from January 1 to April 30. Entries should be addressed to: Award Committee, American Die Casting Institute, 366 Madison Avenue, New York 17, N. Y.

Literature

Citizenship and Participation in Public Affairs

CITIZENSHIP and participation in public affairs, ASME Manual MS-61, is now available for the asking at ASME Headquarter, 29 West 39th Street, New York 18, N. Y.

This interesting 32-page booklet was prepared by the Engineers Civic Responsibility Committee of The American Society of Mechanical Engineers and contains an historical note on the Committee, Engineers Manifesto on Civic Responsibilities, a foreword by Allan R. Cullimore, ASME Manual on Citizenship and Participation in Public Affairs, and the Roy V. Wright Lectures which were established in 1949.

Gasmaking Oils

METHODS of evaluating oils for gasification are presented in two new numbers of the Institute of Gas Technology Research Bulletin Series, No. 9, "Selection of Oils for Carbureted Water Gas," and No. 12, "Selection of Oils for High-Btu Oil Gas." Both are coauthored by E. S. Pettyjohn, director of the Institute, and H. R. Linden, assistant research director.

The bulletins present data on the relationships of the physical and chemical characteristics of petroleum fractions, and of the operating variables, with the enriching values and with the qualities and quantities of the gaseous and liquid products. For the more common gasmaking oils, these data are given in graphic as well as tabular form. Nomographs and equations included in the bulletins permit accurate calculations of these values for any oil, and indicate the operating variables most suitable for the selected oil and most favorable distribution between gaseous and liquid products.

Estimates of enriching value and oil gas yields, arrived at by the methods outlined, were compared with results obtained in plant operation, and found to be in good agreement, demonstrating the reliability of the procedures.

Copies of the bulletins may be purchased from the Institute of Gas Technology, 17 West 34th Street, Chicago 16, Ill. Bulletin No. 9 is $4; No. 12 is $5.

Coal Research

A RECENT Bituminous Coal Research, Inc., "Aid to Industry" publication, "How to Reduce Stack Dust From Small Stationary Plants," shows operators of small stationary plants how to reduce dust (cinder and fly ash) in stack gases.

This publication is the second in the series begun a few months ago by BCR to help coal users get maximum satisfaction from coal and to help coal producers expand their markets.

Particular attention is given to the smaller plants up to approximately 300 boiler hp since study of their problems is not always economically feasible for manufacturers of dust collectors. Factors influencing the quantity of solids in stack gases are reviewed. Suggestions that will aid in lower cinder and fly-ash emission are discussed.

The 12-page, two-color booklet may be obtained from Bituminous Coal Research, Inc., 2609 First National Bank Building, Pittsburgh 22, Pa., for 40 cents a copy in any quantity.

Atomic-Energy Levels

ATOMIC Energy Levels, Volume 2, by Charlotte E. Moore, contains data on 152 spectra of elements having atomic numbers 24 through 41. This volume is the second of a series being prepared at National Bureau of Standards as part of a general program on the compilation of atomic-energy levels derived from analyses of optical spectra. The first volume included the energy levels of 206 spectra of the first 23 elements. This is National Bureau of Standards Circular 467, buckram bound, contains xxxi and 227 pages, it is priced at $2.25, and may be ordered from Government Printing Office, Washington 25, D. C.

Conveyer Terms and Definitions

CONVEYOR Terms and Definitions, a manual on standard nomenclature for conveyer types and parts, has been published by the Conveyor Equipment Manufacturers Association.

The manual contains about 1500 listings and the line drawings of more than 80 types of conveyers and parts. For major items it includes terminology in French, German, Italian,

and Spanish, as well as in English, and is a product of more than three years of work by the Association's Technical Committee which is composed of engineers from all branches of the conveyer industry.

The need, growing over the years, for uniform terms and definitions for the many and varied types of conveyers was emphasized by the experiences of World War II. During that period, it became evident that the Armed Services (even between themselves), civilian agencies, and industry were using different vocabularies in discussing and specifying conveyers.

The 64-page manual defines each type of conveyer by what it "is" rather than by what it "does." The terminology has been adopted by the members of the association and is the official standard for the industry.

The manual is available from the Conveyor Equipment Manufacturers Association, 1 Thomas Circle, Washington 5, D.C.

Fluid Mechanics and Hydraulic Engineering

A REPORT, "Survey of Course Offerings and Text Needs in Fluid Mechanics and Hydraulic Engineering," by Prof. C. E. Kindsvater was prepared as an activity of the Applied Hydraulics Committee of the Civil Engineering Division, American Society for Engineering Education.

The information contained in this report was gathered from a survey of 133 accredited schools of engineering. It should be of interest to everyone concerned with education in the fields of fluid mechanics and hydraulic engineering.

Copies of the report are available for free distribution. Requests for copies should be addressed to Prof. C. E. Kindsvater, School of Civil Engineering, Georgia Institute of Technology, Atlanta, Ga.

Maintenance Problems

A COMPREHENSIVE discussion of plant-maintenance problems is contained in "Techniques of Plant Maintenance—1952."

The book, which contains the proceedings of the conference, is highlighted by the text of 717 questions propounded by 2100 engineers from every major industry in the country who attended the sessions. The book thus represents the best cross section of current industrial engineering thought on maintenance problems.

Texts of all papers read at panels led by 36 outstanding leaders in the field are included, and the papers are illustrated by 49 charts, diagrams, graphs, and tables. Also included is a manual for a lower repair and maintenance-cost program, prepared by Westinghouse Electric Corporation.

The volume contains 182 pages, $8\frac{1}{2} \times 11$ in., is available postpaid for $6 from Clapp and Poliak, Inc., 341 Madison Ave., New York 17.

Dust Control

DUST and fume control in a multitude of process industries is the subject of a comprehensive brochure, "Industry Relies on Dustube for Efficient Dust and Fume Control," just published by American Wheelabrator & Equipment Corporation, 1149 S. Byrkit Street, Mishawaka, Ind.

Copies of this interesting brochure may be obtained from American Wheelabrator & Equipment Corporation upon request.

Industrial Engineering

THE Proceedings of the Fourth Annual Industrial Engineering Institute held in co-operation with The American Society of Mechanical Engineers, the American Institute of Industrial Engineers, the Society for Advancement of Management, and the Society of Applied Industrial Engineers at the University of California, Berkeley, Feb. 1–2, 1952, and the University of California, Los Angeles, Feb. 4–5, 1952, are now available.

The more than 20 illustrated papers presented by leading authorities in the field of industrial and management engineering make this a most worth-while contribution to the latest information on time and motion study, wage incentives, and quality control. The papers were edited by D. G. Malcolm, Jun. ASME.

Copies of these proceeding may be ordered directly from the publisher, The Elliott Printing Company, 1016 Jackson Street, Oakland, Calif., at $2.75 a copy.

Fiat

FIAT—A Fifty Years' Record, is a fascinating volume of reminiscences, studies, and other writing depicting the life of the Fiat Company of Italy. Primarily it is dedicated to the memory of Giovanni Agnelli, who laid the foundation of the Fiat and was the principal figure behind its outstanding development. The book also honors his early collaborators and the workers, both intellectual and manual, who played a part in this great achievement of Italian workmanship.

The book is fully illustrated, contains many colored plates and vividly tells the story of industrial development in the face of two wars.

Harwell

HARWELL: The British Atomic Energy Research Establishment, 1946–1951, is an interesting story of the origin and organization of Harwell and in a way the story of the British atomic-energy program, prepared by the Ministry of Supply and the Central Office of Information.

The book tells of the various programs undertaken at Harwell such as production, isotope, reactor, accelerator, and so on; the problems encountered, the health work, research, and extramural relations. Here also are listed the scientific papers by the staff, and a reading list and glossary. The advance copy of the book sold for $3.75.

Rod Handbook

THE Copper-Base Alloy Rod Handbook was recently published by the Copper & Brass Research Association. The handbook contains a considerable amount of valuable information not previously published.

While the handbook was prepared primarily for engineers and mechanics engaged in specifying and working with copper and copper alloy rod—including brass, bronze, and nickel silver—it is also believed that many other technicians, manufacturers, designers, and purchasing people will find it useful and informative.

It provides pertinent data about free-cutting brass and other copper-base alloys in the form of rod for screw-machine products, and should assist the user in the selection of the proper copper-base alloys when conditions require that some special property of an alloy must be emphasized.

One of the principal features of this handbook is a comprehensive chapter on machining which provides complete and authoritative information on this subject, as it relates to copper and copper-base alloys. Numerous drawings and tables will be of inestimable help.

Copies of this handbook may be obtained without obligation by request to the Copper & Brass Research Association, 420 Lexington Avenue, New York 17, N. Y.

NBS Annual Report

THE Annual Report 1951, National Bureau of Standards, summaries scientific and engineering investigations conducted by NBS during the fiscal year 1951. This booklet contains accounts of current activities as well as more detailed descriptions of especially important scientific developments. Its text provides a general description of work done in the 15 scientific and technical divisions and gives many specific examples of significant projects at NBS during the year.

The 105-page report, National Bureau of Standards Miscellaneous Publication 204, is illustrated and may be obtained from Government Printing Office, Washington 25, D. C., for 25 cents a copy.

Special Amortization

A NEW MAPI research study, "Amortization of Defense Facilities," was published recently.

As the first comprehensive and systematic analysis of the use of accelerated tax amortization during war and defense emergencies, this MAPI publication merits the serious study of business executives, students, government administrators, and legisalators.

The study is being given wide distribution, particularly to Congressional committees concerned with special amortization and to administrative agencies having primary responsibility in this area. Copies may be obtained from the MAPI Chicago office, 120 South LaSalle Street, Chicago 3, Ill.

British Engineering Conference

THE Proceedings of the Joint Engineering Conference, 1951, held in London, England, and arranged by The Institution of Civil Engineers, The Institution of Mechanical Engineers, and The Institution of Electrical

Engineers, records the impressive story of British engineering achievements and is a useful review of the progress of engineering during the past century.

The Proceedings are divided into eleven parts as follows: 1 General Report, 2 Railways, 3 Sea Transport, 4 Power, 5 Aviation, 6 Education and Training, 7 Road Transport, 8 Telecommunications, 9 Public Health, 10 Gasworks, Steelworks, Mining, 11 Electrical Measurements, Television, Gas-Pressure Cables, Lighting.

The Proceedings are available at 8s 6d for each part or a complete set of parts at £3 10s.

Traffic Safety

HERE'S How, the first edition of this booklet published in 1949, was the answer to requests for guidance in how to stage a traffic-safety program or project at state and local levels. "Here's How," the second or present edition, is a catalog of proved accident-prevention projects. Public support groups especially will find this publication invaluable.

Copies may be obtained at no cost from the National Association of Automotive Insurance Companies, 20 N. Wacker Drive, Chicago, Ill.

THIS Is Our Traffic Safety Program, is an attractive booklet in which the Association of Casualty & Surety Companies takes a firm stand and states its belief and its traffic-safety program, step by step. In the confidence that highway-accident prevention involves both technical projects and public education, the association lists ten traffic-safety activities to which it promises wide support.

A limited supply of this booklet is available upon request to the Association of Casualty & Surety Companies, 60 John Street, New York, N. Y.

USAF Research and Development

AN INTERESTING 32-page booklet has been published to acquaint industry with the new Air Force Research and Development Organization and to answer many questions about procurement and contractual procedures, for both present and potential contractors, on handling research and development business for the Air Force.

Copies of the booklet may be obtained by addressing requests to the Commanding General, Headquarters, Air Research and Development Command, P. O. Box 1395, Baltimore 3, Md., Attention: Director of Procurement, Contractors' Relations Office.

Pressed Metal

TRANSCRIPTS covering the third spring technical meeting of the Pressed Metal Institute are now available and can be secured by writing to the Institute. Cost $5.00 per copy.

This transcript covers the sessions on: Tooling for short runs, estimating factors and cost analysis for intelligent stamping quotations, technical knowledge for stamping salesmen, and practical quality control for stamping plants.

Time Study and Methods

THE Proceedings of the Seventh Annual Time Study and Methods Conference, April 24-25, 1952, comprising 16 papers by specialists in fields of operative management, has been published by the Society for Advancement of Management. The practical, proved plans and basic principles and theories discussed by the authors cover the application of time study and methods to cost control; tools, equipment, and layout; planning, scheduling, and inventory control; maintenance; inspection, material handling, SAM Rating Films, and many others.

The Proceedings may be purchased from the Society for Advancement of Management, Inc., 411 Fifth Avenue, New York 16, N. Y., for $5 to nonmembers; $3 to members.

Welding

A NEW, 1952 edition of the "Rules for Field Welding of Steel Storage Tanks" has just been issued by the American Welding Society. This old, recognized, and widely-used standard for the first time now includes provisions for the use of automatic welding in the fabrication of storage tanks for storing liquids at not over 15-psi gage pressure.

The existing Rules have been revised to cover the qualification of welding procedures and welding operators for automatic welding and related requirements throughout.

Provision is also made for the use of low-hydrogen electrodes for manual arc welding. The requirements for manual welding have been reviewed and brought up to date as necessary.

The recent trend to greater pressures and temperatures for marine piping has led to the use of alloy-steel piping. This required revision of existing rules and regulations governing the welding of piping, which were intended for carbon steel only. The AWS Marine Committee has just completed the "Rules for Welding Piping in Marine Construction—Ferritic Alloy Steels," which contains the requirements for joint design, electrodes, welding procedures, postheat, preheat, stress relief, and testing of welded ferritic alloy-steel pipe joints. Included is a radiographic standard for evaluating weld quality, as well as nondestructive test requirements.

These Rules represent requirements which are acceptable to all the Enforcement Agencies in the shipbuilding industry.

Copies are available at 50 cents each from American Welding Society, 33 West 39th Street, New York 18, N. Y.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, Jan. 21, 1953

A MEETING of the Executive Committee of the ASME Council was held in the rooms of the Society on Jan. 21, 1953. F. S. Blackall, jr., chairman, presided. In addition to Mr. Blackall there were present: H. E. Martin, A. C. Pasini, E. S. Theiss, and W. F. Thompson of the Committee; E. J. Kates, assistant treasurer; H. R. Kessler, vice-president; James D. Cunningham and E. W. O'Brien, past-presidents; C. E. Davies, secretary, and Ernest Hartford, executive assistant secretary. The following actions were of general interest:

Appropriation for Research Program

At a previous meeting the Council approved and authorized putting into effect recommendations of the Special Research Review Committee and further authorized an appropriation of $7500 from Research Reserve for the program. This appropriation, which was subject to review by the Finance Committee, has now been approved.

Sixty-Five-Year Members

Special certificates for their 65 years of ASME membership were authorized for Ralph E. Curtis, Danvers, Mass., William O. Hildreth, Syracuse, N. Y., and Spencer Miller, Sr., Longmeadow, Mass.

ASME Public Relations

A report on the Society's public-relations policy was submitted some time ago by a subcommittee consisting of T. A. Marshall, Jr. and Glenn Fryling. This subcommittee was appointed by the Meetings Committee to study the situation. Action on its report was withheld but it was voted to request the Finance Committee to set aside $2500 in the current budget for the recommended research on an adequate ASME public-relations program.

Machine-Tool Award

Action of the National Machine Tool Builders Association was reported whereby papers considered for the Machine Tool Design and Economic Value Award may have two joint authors, the award to be divided equally between the two.

Changes in Atomic-Energy Law

It was reported that the Nuclear Energy Application Committee is undertaking the preparation of ideas for presentation to the Joint Committee on Atomic Energy concerning changes in the Atomic Energy Act of 1946 needed to encourage ventures by privately-owned industries in the atomic-energy field. Because it was felt that a presentation by Engineers Joint Council would be more representative than one solely from the ASME, it was voted to propose to the EJC that it establish a panel to prepare and present such a statement on changes to the Joint Committee.

IIRD Custodian Fund

Several companies have offered to contribute to expenses of foreign speakers on the

IIRD program for the 1953 Annual Meeting. The establishment of a custodian fund for the purpose of paying these expenses was authorized—subject to review—to be known as the IIRD Dynamic Systems Committee Custodian Fund.

Appropriations to Sections

To provide additional important service for members through Section activities, it was voted to amplify present payments to the Sections (standard formula, plus 25 per cent) with supplementary payments equal to one third of a dollar for each paid-up member in the Section on September 30, to be made only on specific request from the Section showing necessity for it.

It was also voted to request the vice-presidents to review this plan and to request the Finance Committee to include $10,000, estimated additional cost of the plan, in the revision of the budget for the current year.

Certificates of Award

Certificates of Award were granted to C. B. Campbell, retiring chairman of the Publications Committee and to Carl B. Vance, Central Indiana; and Daniel J. Greenwald, Jr., Minnesota, retiring Section chairmen.

American Power Conference

The Society's cosponsorship of the American Power Conference to be held in Chicago, March 25–27, 1953, was authorized.

James Watt International Medal

Announcement was received of the award of the 1953 James Watt International Medal to Sir Harry Ricardo, Hon. Mem. ASME.

Joint Engineering Conference

The Institution of Mechanical Engineers (Great Britain), jointly with the Institution of Civil Engineers and the Institution of Electrical Engineers, have presented to the Society a 529-page volume of the proceedings of the Joint Engineering Conference held in London, June, 1951. This volume records the story of British engineering achievements during the past 100 years.

ASEE Appropriation

It was voted to refer to the Finance Committee, for favorable consideration, the request for an appropriation of $700 to support the work of the ASEE Committee on the Evaluation of Engineering Education.

Appointments

The Committee approved the appointments on Committees and Joint Activities recommended by the Organization Committee. These appointments appear in the ASME publication, "Personnel of Council, Boards, and Committees for 1953," available upon request to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

EJC Reorganizes Under New Constitution

A MEETING of the Engineers Joint Council was held in the Engineering Societies Building, New York, N. Y., on Jan. 23, 1953. Representatives of The American Society of Mechanical Engineers present were: R. J. S. Pigott, B. P. Graves, R. L. Goetzenberger, C. E. Davies, secretary; E. J. Kates, alternate, and H. R. Kessler, alternate. Also present were representatives of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers, the American Society for Engineering Education, and The Society of Naval Architects and Marine Engineers.

Significance of Meeting

Significance of this meeting lay in the fact that it was the first since the adoption of the new EJC constitution on Dec. 7, 1952 (see MECHANICAL ENGINEERING, February, 1953, pp. 180–181) under which the number of constituent societies was increased and a new procedure was adopted on the appointment of society representatives. In a sense a reorganization meeting, the chair was taken by T. A. Marshall, Jr., secretary of EJC.

Expansion of EJC

It was reported that of the seven societies to which invitations had been sent to join EJC, acceptance had been received from The Society of Naval Architects and Marine Engineers and the American Society for Engineering Education. SNAME will be represented by J. H. King and ASEE by Thorndike Saville, with F. M. Dawson as alternate.

The American Association of Engineers had designated James H. Griffin to attend meetings as an observer. The National Society of Professional Engineers in a letter to EJC, stated that the invitation would be considered by the Board of Directors at the society's annual meeting in June, 1953. C. T. Shoch and R. E. Allen were appointed as observers in the interim. The Institute of Radio Engineers in a letter stated that their Board of Directors was considering the invitation. IRE designated B. E. Shackelford and the president as observers.

Election of Officers

T. A. Marshall, Jr., was elected as president, pro tem. After suggestions from each society, he appointed a Nominating Committee, composed of one representative from each of the seven constituent societies, to prepare a slate for president, vice-president, and four members of the executive committee. The following were appointed to the Nominating Committee: W. N. Carey, ASCE; E. H. Robie, AIME; E. J. Kates, ASME; T. G. LeClair, AIEE; J. H. King, SNAME; T. Saville, ASEE; and R. P. Kite, AIChE.

After a recess during which the Nominating Committee met, the following nominations were submitted and accepted: R. J. S. Pigott (ASME), president EJC; Thorndike Saville (ASEE), vice-president EJC; and Carlton S. Proctor (ASCE), W. N. Peirce (AIME), T. G. LeClair (AIEE), and R. P. Kite (AIChE), Executive Committee.

Adoption of Constitution

At the Executive Committee meeting on Dec. 19, 1952, it was reported that action by AIChE had resulted in the adoption of the new constitution as of Dec. 7, 1952.

Incorporation of EJC

W. N. Carey reported on the difficulties encountered in efforts to incorporate EJC. After discussion, it was voted that EJC recommend to its constituent societies that each use its influence on its New York State units toward amending Section 7209, Sub-Division 1 of the New York State Education Law, by changing the end of the first sentence from "composed exclusively of professional engineers" to "organized for the advancement of the science and profession of engineering and not engaged or authorized to engage in the practice of professional engineering."

Mr. Carey also pointed out the advisibility of adding a fourth purpose in Article I, Section 2, of the EJC constitution which delineates its objectives. After discussion it was voted to amend Article I, Section 2, of the constitution by inserting a new sentence to be identified as sub-section (*c*) to read "(*c*) to advance the science and profession of engineering."

Labor Legislation Panel

E. L. Chandler asked the Council to clarify its action of Dec. 19, 1952, in which the Labor Legislation Panel was directed to prepare a basic statement that might be suitable for publication by the constituent societies in connection with the unionization of engineers. After discussion the president was authorized to designate a special committee to review the EJC 1947 statement of policy and present a modified statement for approval by the next meeting. The following were then appointed to the committee: C. S. Purnell, chairman; C. T. Shoch, E. L. Chandler, J. H. King, and R. L. Goetzenberger.

The president was also authorized to designate a special committee composed of a member of the Special Surveys Committee, a representative of ECPD, and three members of EJC, to prepare a program of education on the whole matter of unionization of engineers. The following committee was appointed: H. N. Muller, Jr., Special Surveys Committee, chairman; E. L. Chandler, G. A. Hathaway, R. P. Kite, and B. P. Graves.

UPADI

E. A. Pratt reported on the financial situation of the Pan-American Federation of Engineering Societies (UPADI). He stated that a UPADI Fund was being created to solicit support from industry in both North and South America to cover UPADI's financial needs. This matter was discussed at an informal meeting held Jan. 16, 1953. Upon Mr. Pratt's recommendation and after discussion, it was voted that EJC recommend to its constituent societies the approval of a loan by EJC of $4500, to the UPADI Fund, for the purpose of covering immediate financial needs of UPADI, the loan to be made after the Fund becomes a legal entity.

Constitution and By-Laws

H. S. Osborne, chairman, Committee on Constitution and By-Laws, discussed the pos-

sibility of changes which might be necessary in the constitution. The president then directed this committee to examine the constitution and make recommendations for changes and for necessary by-laws to insure proper operation of the Council.

Engineering Manpower Commission

Upon recommendation of the Engineering Manpower Commission, T. H. Chilton was designed chairman of the Commission for 1953 to succeed C. H. Brown.

National Scientific Register

Upon recommendation of C. E. Davies and after discussion, the president was authorized to appoint a Task Committee to work with the National Science Foundation in developing a workable Engineering Register for the National Science Register. The following committee was appointed: S. L. Tyler, chairman; T. A. Marshall, Jr., secretary; W. N. Carey, E. H. Robie, C. E. Davies, H. H. Henline, W. N. Landers, and A. B. Bronwell.

Creative Frontiers, Inc.

In response to a request from Miss Celia Raeder, the secretary of EJC was authorized to request each of the constituent societies to designate an individual to act as a liaison and technical adviser in the preparation of specific programs for Creative Frontiers, Inc.

Tax-Favored Pensions for the Self-Employed

E. L. Chandler reported on the Reed-Keogh Bill and the new bill H.R. 11 which was introduced before the present Congress. He was requested to prepare a statement for signature by the president of EJC asking for the opportunity of a hearing on the new bill.

Atomic Energy

A letter dated Jan. 22, 1953, was read, reporting action of the ASME executive committee in connection with possible changes in the Atomic Energy Act of 1946 needed "to encourage ventures by privately owned industries in this field." It was recommended that EJC establish a panel for this purpose. After discussion it was voted to establish a panel on atomic energy for the purpose of presenting ideas concerning changes in the Atomic Energy Act to the Joint Committee on Atomic Energy.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Mechanical Engineer, M.I.T. graduate, one year assistant plant engineer copper mill; four and a half years assistant and chief engineer merchant and naval vessels. Seeks position in heat, power, air conditioning, or plant engineering. Me-936.

Manager, 15 years' diversified research, engineering, business experience. Proved ability to stimulate creative thinking and develop hard-hitting teams. Desires opportunity in rubber, plastic, paper, textile, or automatic machinery field. Me-937.

Development Engineer, BSME, PE, 32, to apply proved ingenuity developing automatic machinery, business machines, mechanical computing devices. Eight years mechanical and electromechanical component and system development. Prefers lower Conn., Westchester, L. I. Me-938.

Mechanical Engineer, 30, married, practical experience in design and development, some maintenance experience. At present doing development work in supervisory capacity. Desires design job in East or South. Available four weeks after agreement reached. Me-939.

Mechanical Engineer, Stevens, ME, MS, PE, ten years' diversified experience in product design, mechanical development, production and administrative engineering in the fields of communications, electromechanical equipment, and aircraft. Desires responsible association with engineering office or small medium-size manufacturing organization. New York City area. Me-940.

Chief Power Plant Engineer, 46, 20 years' experience in three positions as assistant chief engineer, chief engineer, and manager of hydro and steam-electric system. Seeks permanent position supervising modern steam-electric utility or industrial plant. Me-941.

Mechanical Engineer, 35, married, college graduate, ten years' experience in pipe line construction, operation, and maintenance, including gas metering, flow and pressure-control design. Desires responsible operating or construction position. Available two weeks' notice. Me-942-517-D-8.

Mechanical Engineer qualified to handle air-pollution-control problems and correlated waste-disposal problems; analysis of problem; comprehensive report; equipment for correction; public relations; liaison with production staff. Me-943.

Manufacturing Executive, 44, registered PE, BSME, BSAE, 20 years' engineering and manufacturing experience, 12 years in top-level management. Successful works manager and director of engineering, director of reorganization, assistant to the president. Managing director in Paris, France. Me-944.

Mechanical Engineer, 29, BS, executive potential desires change from present design work to position requiring more initiative and capability. Experience in export, investment, and business. Me-945.

Mechanical Engineer, PE, presently employed as air-conditioning engineer for large industrial plant. Experienced in the design-application operation and maintenance of air-conditioning, refrigeration, and heating equipment. Me-946.

Mechanical Engineer, 1952 graduate, BSME, 29, six months machine design work; five and a half years broad machine-shop experience. Pursuing master's, presently employed. Desires methods or production-engineering work with manufacturing company. Me-947.

Associate Professor, MSME, 38, married, registered engineer. Over 12 years' combined college teaching and industrial experience. Desires teaching position in West. Will consider other locations. Available September, 1953. Me-948-502-D-5.

Positions Available

Engineers. (*a*) Sales engineer, at least five years' sales experience in power-plant-accessories field, to sell expansion joints, fittings, pipe hangers, etc. $6000–$7000. (*b*) Mechanical engineer with piping-stress-analysis experience, to analyze projects, prepare specifications, lay out, and detail piping installations. $5000–$6000. New York, N. Y. Must be resident of metropolitan area. Y-8084.

Process Engineer, 28–30, mechanical graduate, three or four years' experience in time study and methods, preferably in process industry. $6000. New York, N. Y. Y-8088.

Estimating Engineer, at least ten years' project, methods, and estimating experience covering machining, stamping, forging, and fabricating aircraft and ordnance materiel. Some traveling. $10,000–$12,000. New York, N. Y. Y-8093.

Chief Production or Process Engineer to develop schedules, process sheets, routing, etc., on heavy equipment and machinery under job-shop conditions. Knowledge of heavy weldments necessary. To $15,000. Northern N. J. Y-8099.

Manager of Methods, 35–40, in company-wide staff capacity for major busines-machine applications, punch-card systems, and electronic controls. $18,000–$20,000. Mich. Y-8100.

Engineer, executive ability, to be trained to assume executive responsibility. Must be well versed in time and motion study and have a thorough knowledge of costs and incentive systems. Should have experience in office control and procedures as well as plant methods and procedures. $7000–$9000. Upstate N. Y. Y-8106.

Works Manager for a hardware plant of 350 people. About 40 years of age, engineering degree, preferably ME; experience must include machine-shop operations, tool and diemaking, industrial engineering, labor relations, and union negotiations; direct supervision and management. Must be able to deal successfully with people; must be executive material capable of advancement. Will start as assistant to the executive vice-president. About $16,000. Ill. Y-8110.

Chief Industrial Engineer, executive, administrative, and cost-reduction experience for textile-apparel manufacturers with plants in eastern states. $12,000. Headquarters, New York metropolitan area. Y-8124.

Design Engineer, mechanical graduate, experience on design and layout of intricate mechanisms for ordnance research project. $5000–$6000. New York, N. Y. Y-8126.

Mechanical Maintenance Supervisor, minimum of eight years' supervisory experience in fabrication, installation, and maintenance of chemical and pharmaceutical equipment. Must be able to direct the work of large groups of skilled pipefitters, millwrights, electricians, and machinists. New York State. Y-8127.

Plant Manager capable of running a medium-sized plant, including production, personnel, etc., manufacturing kitchen enamelware. Two-year contract. $15,000–$18,000. Columbia, S. A. Y-8137.

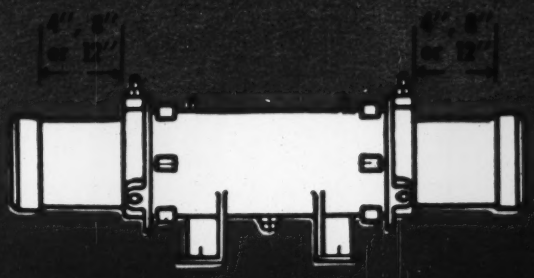
Centrifugal-Pump Designer, preferably with ten or more years' experience in designing and testing centrifugal pumps. Experience should include single-stage single-suction, single-stage double-suction, and multistage pumps. Pa. Y-8169.

Engineers. (*a*) Product engineer, some experience in tool design and design for production, methods, etc., for stampings, plastics, etc. $8000. (*b*) Design engineer, mechanical graduate, preferably with minimum of five to ten years' experience in metal stampings such as are used in business machines. Some knowledge of automatic machinery. $8000. Southern Ohio. Y-8170.

(*ASME News continued on page 272*)

[1] All men listed hold some form of ASME membership.

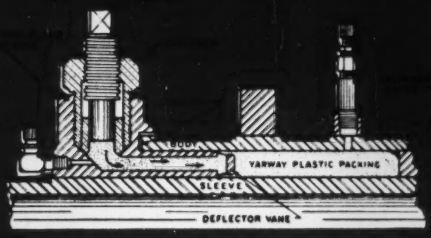
YOU NEED FEWER JOINTS



With Yarway Gun-Pakt slip-type expansion joints you need fewer joints than with other types, because each sliding sleeve has a traverse of 4", 8" or 12" . . . maximum expansion being 24" for a double-end joint.

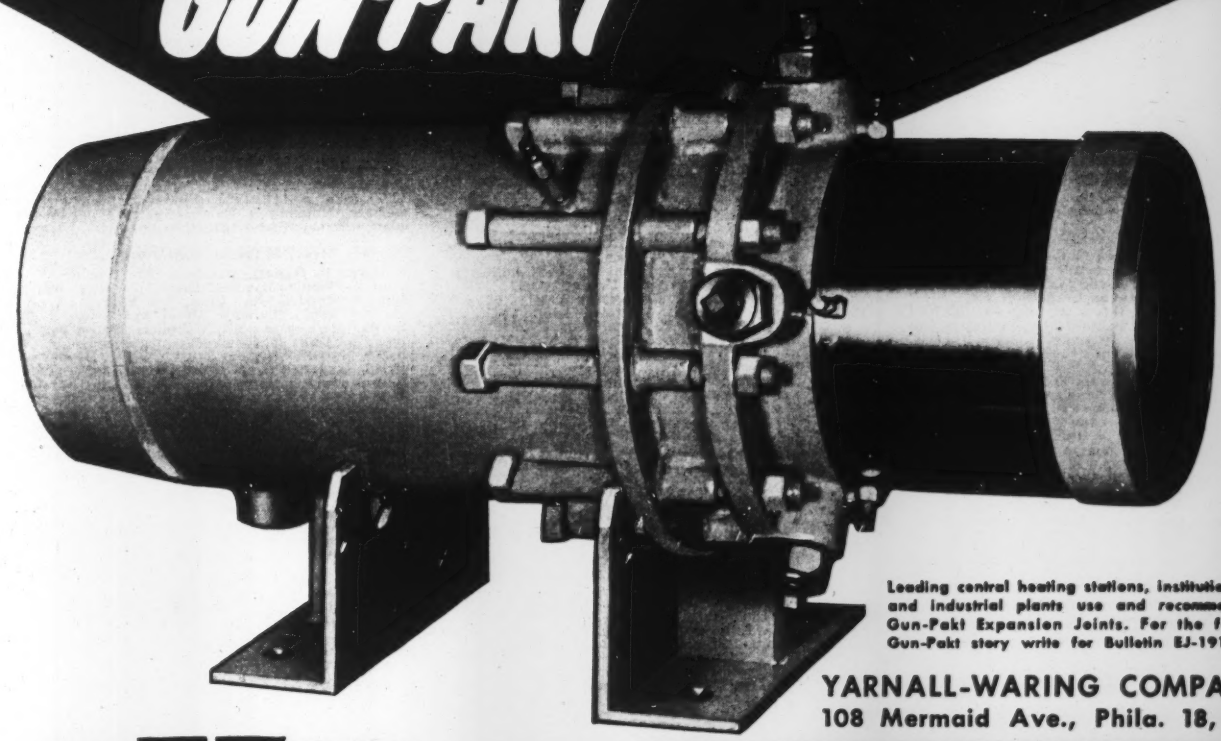
For example, one single-end Yarway Gun-Pakt joint with an 8" traverse is all that is needed for 200 ft. run of steel pipe carrying saturated steam at 250 psi.

AND LESS MAINTENANCE



No need for shutdowns. Yarway Gun-Pakt joints are serviced under full steam pressure and temperature by a plug of Yarway plastic packing. Just a screwdriver and the job is done. Maintenance cost practically zero.

W GUN-PAKT ints



Leading central heating stations, institutions and industrial plants use and recommend Gun-Pakt Expansion Joints. For the full Gun-Pakt story write for Bulletin EJ-1912.

YARNALL-WARING COMPANY
108 Mermaid Ave., Phila. 18, Pa.

YARWAY GUN-PAKT EXPANSION JOINT

Production Manager, at least ten years' experience in watchmaking, recording instrument, or small precision-gear fields. Must be citizen. $10,000. Queens, N. Y. Y-8173.

Works Manager, 40–50, for nationally-known manufacturer of business machines and related equipment. Should have extensive knowledge of manufacturing techniques such as are employed in the electromechanical field and a knowledge of machine tools, production engineering, production control systems, and industrial engineering. Will take charge of all production activities. To $18,000. Eastern seaboard. Y-8186.

Plant Manager, 35–40, mechanical or industrial graduate, to operate 600–800-man plant, producing medium and heavy parts. Operations include ferrous foundry, machining, and assembling operations. Must have experience as plant manager, assistant plant manager, or industrial engineer in medium-sized plant engaged in industrial manufacturing. Extensive experience in machining and assembling required. Knowledge and understanding of foundry operations desirable. Ohio. Y-8195.

Production Engineer, mechanical or metallurgical-engineering training and at least ten years' stainless-steel strip-mill experience $8000–$10,000. Canada. Y-8213.

Sales Engineer, mechanical or electrical, electronic and instrument experience for sales, promotion, installation, and service of wire-wrapping tool to form solderless connection. $6000–$8000. Some traveling. Midwest. Y-8219.

General Operating Superintendent, 35–40, engineering background, experience in manufacturing, light industry, with or without previous retail experience for important executive responsibility offering future development with large southern department store. Write giving details of qualifications and salary requirements. Y-8222.

Instructors, mechanical or civil graduates, with good scholastic record, to teach engineering drawing and descriptive geometry. Positions start September, 1953. To $4000 for nine months. Ill. T-9523.

Engineers. (*a*) Product engineer, mechanical degree, experienced in steam-specialty-control fields. Experience in design of pneumatic controls and high-pressure control valves desirable. Must have executive ability. Knowledge of thermodynamics, applied mechanics, and general practices in power plants and chemical industries desirable. Up to $10,000. (*b*) Designer, mechanical, familiar with design and operation of heat-transfer equipment, deaerating heaters, and accessories, to take charge of engineering in this department. Up to $8000. (*c*) Project engineer to handle post-order engineering work with customers, district offices, and shop in company manufacturing automatic controls, valves, and steam specialities. Must have executive ability. Engineering degree and general knowledge of thermodynamics and general practices in power plants and chemical industries necessary. Up to $8000. (*d*) Research and development engineer for company manufacturing automatic controls and power-plant specialties. Must be graduate in mechanical or electrical engineering. Up to $8000. Exceptional opportunities for men with creative ability and originality. Ohio. T-9548.

Product Designer, up to 45, four years' or more experience in designing building products such as storm windows and extrusion-press products. Knowledge of aluminum fabrication. Will do product design on storm windows and allied products for a manufacturer. $7500–$8500. Employer may negotiate placement fee. Mich. T-9579.

Chief Project Engineer, for design and development of household appliances, 35–45, strong in administrative field as development program will be arranged by projects, each one consisting of manufacturers' principal product. Each project under guidance of supervisor reporting to project engineer. Must have experience in appliance field and well experienced in manufacturing and engineering methods. Capable of assuming duties of director of research and engineering. Principal duties consist of co-ordination and following through on each project under way. Knowledge of modern finishes on appliances, plastics, sheet metals, and application of mechanical principles essential. Company will pay fee. $12,000–$15,000. Iowa. T-9609.

Sales Engineer, 25–40, at least two years' experience in general engineering of automatic controls and preferably some sales background. Knowledge of automatic controls helpful. Duties will be in office handling quotations, telephone, and general sales-office work, for manufacturer of controls. $5000–$8000. Company will pay fee. Ill. R-9531.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after March 25, 1953, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

For member, Associate, or Junior

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

NEW APPLICATIONS

ADAMS, JOHN L., South Charleston, W. Va.
ALFROD, JOSEPH S., Cincinnati, Ohio
ALSTON, CLYDE M., New Hyde Park, N. Y.
BALL, MYRON L., Atlanta, Ga.
BALSAM, DAVIS M., Long Island City, N. Y.
BARNES, ELLIS H., JR., Baltimore, Md.
BARTELL, RICHARD J., Cedar Rapids, Iowa
BEHR, ROBERT K., Tuckahoe, N. Y.
BENNETT, JAMES E., San Antonio, Texas
BERB, NAUM S., Trona, Calif.
BLACKMAN, STEWART, Miami, Fla.
BOSLEY, DEWEY R., Butler, Pa.
CAMPBELL, LYLE K., Salt Lake City, Utah
CAMPBELL, WALKER R., Amarillo, Texas
CARLSON, WILLIAM G., Shaker Heights, Ohio
CENTRANGELO, LOUIS, South Norwalk, Conn.
CEYLAN, NIJAD A., Wilmington, Del.
CHEN, BU-SHING, Melbourne, Fla.
COLE, IRVING V., Leonia, N. J.
COLLETT, CHARLES T., Washington, D. C.
CUNNINGHAM, JOHN C., New Haven, Conn.
DAVIES, CYRIL B., Chester, England
DENISON, ROBERT R., Houston, Texas
DOBSON, ALBERT, Montreal, Que., Can.
DORSAK, JOHN W., Cleveland, Ohio
DUPRIES, HENRY, Worcester, Mass.
EBER, GERHARD R., Silver Spring, Md.
ELSTON, WARREN D., Walnut Creek, Calif.
EUSTIS, ROBERT H., Elkins Park, Pa.
FINK, RICHARD J., Lynbrook, L. I., N. Y.
FISHER, FRANK D., San Carlos, Calif.
FLAHERTY, EDWARD J., Jersey City, N. J.
FRASIK, ROLAND M., Detroit, Mich.
FREIBURGHOUSE, EDWARD H., JR., Ballston Spa, N. Y.
FRINK, JAMES C., New York, N. Y.
GEBUHR, JOHN V., Des Moines, Iowa
GERBERG, BERNARD, Perth Amboy, N. J.
GILL, MALCOLM E., Emmaus, Pa. (Rt & T)
GOFF, WILLIAM R., Charleston, W. Va.
GOSS, CHARLES L., Sidney, Ohio
HAGE, ROBERT W., Chicago, Ill.
HAZLE, JOHN R., Shawinigan Falls, Que., Can.
HINRICHS, ALAN D., Paramus, N. J.
HYMAN, SEYMOUR C., New York, N. Y.
IRWIN, DONALD E., Scotia, N. Y.
JACOB, HARRY J., JR., Toledo, Ohio
JOHNSON, ALVA A., East Pittsburgh, Pa.
JOHNSON, FRANKLIN C., JR., Takoma Park, Md.
KAPLAN, ROBERT P., Rochester, N. Y.
KRAMER, DAVID C., Redondo Beach, Calif.
KRIEGER, KENNETH A., Detroit, Mich.
KRUSE, MERLE E., Pittsburgh, Pa.
LAWTON, RUSSELL W., Los Angeles, Calif.
LEWIS, DELBERT F., Tulsa, Okla.
LINTHWAITE, PAUL E., Wyckoff, N. J. (Rt & T)
LOCKETT, PAUL F., Newark, Ohio (Rt & T)
LUMADUE, CLYDE R., Burlington, N. J.
LUNDBERG, HARRY E., Stamford, Conn.
LYNN, CLARENCE, Buffalo, N. Y.
MARKEZICH, NICHOLAS L., Oak Lawn, Ill.
MARSELLI, EDWARD M., Metropolis, Ill.
MASE, RICHARD D., Levittown, N. Y.
MATTHEW, PAUL, Berkeley, Calif.
MCCOY, LARRY J., Lubbock, Texas
MEIJER, CONRAD F., Glasgow, Scotland
MEIKRANTZ, JOHN G., Allentown, Pa.
MICHIELS, MAURICE, Rutherford, N. J.
MILLER, WARD E., Hammond, Ind.
MONETTE, ROBERT J., JR., Columbia, S. C.
NORTON, HOWARD M., San Francisco, Calif.
NUTKINS, DEREK J., San Diego, Calif.
OXFORD, CARL J., JR., Rochester, Mich.
PAGET, HAROLD D., Windsor, Ont., Can.
PARLIN, RAYMOND W., New Bedford, Mass.
PEDRICK, WILLIAM J., JR., New York, N. Y.
PELA, EDWARD A., Augusta, Ga.
PERRILL, RODNEY S., Morton Grove, Ill.
PESCE, JOSEPH D., Floral Park, N. Y. (Rt & T)
PETERSON, ROBERT G., Phoenix, Ariz.
PHILLIPS, HENRY, New York, N. Y.
PLOPPER, GEORGE E., Davis, Calif.
POLAND, CLARK L., Oradell, N. J.
POLEY, STANLEY, New York, N. Y.
RAMSDELL, WILLIAM H., Shreveport, La.
REAVES, BILLY M., Hartsville, S. C.
REEDY, JOHN E., Columbus, Ohio
REMENYI, JOSEPH J., Dayton, Ohio
RICHER, HUGO R., San Antonio, Texas
ROSS, JAMES L., Kansas City, Mo.
ROSS, JOHN R., Cleveland, Ohio
SARKAR, PARITOSH K., Singapore, Malaya
SAVITSKI, MICHAEL J., Dayton, Ohio
SEYMOUR, JOHN H., Toronto, Ont., Can. (Rt & T)
SHARPLESS, ROBERT L., Toledo, Ohio
SMITH, SPENCER B., New York, N. Y.
SNARR, JAMES I., Ottawa, Ont., Can.
STONE, HENRY E., Schenectady, N. Y.
SWEENEY, JOHN H., Newark, Del.
SYLVESTER, EDMUND Q., Chicago, Ill.
SYLVESTER, JAMES G., South Weymouth, Mass.
SZYMANSKI, WALTER C., Omaha, Neb.
TOTTEN, JOHN M., Boston, Mass. (Rt & T)
TULLIS, LYELI C., Evansville, Ind.
VALES, JULIO M., Montevideo, Uruguay
VAN ACKER, FRANK, New York, N. Y.
VAN DER HORST, JOHANNES M. A., Portville, N. Y.
VENKATA ROW, NISHTALA, Bombay, India
VICKERY, ELWOOD W., Syracuse, N. Y.
WALKER, ROBERT J., Houston, Texas
WATSON, ALFRED, Buffalo, N. Y.
WEAVER, CHARLES H., Pittsburgh, Pa.
WHALEN, JOHN F., Chicago, Ill.
WIEDIS, ROBERT, Maywood, N. J.
WRIGHT, ARTHUR E., San Antonio, Texas
YEILDING, RALPH D., Texas City, Texas
YODER, RICHARD E., Wilmington, Del.
YOUNG, ROBERT E., Holmes, Pa.
ZMUDKA, EDWIN M., North Riverside, Ill.

CHANGE IN GRADING

Transfers to Member and Associate

ANCKER, CLINTON J., JR., Berkeley, Calif.
BAXTER, MERIWETHER L., JR., Rochester, N. Y.
BLUM, ROGER C., Scarsdale, N. Y.
CASE, LYNN B., Federalsburg, Md.
EITEL, WILLIAM W., JR., Baltimore, Md.
FUTRAL, SAMUEL M., JR., Evanston, Ill.
HAUGER, HARRY H., JR., Los Angeles, Calif.
MOORTHY, KANDUKURU R., Kolhapur, India
RATTENBURY, DAVID J., Vancouver, B. C., Can.
SCHUERHOLZ, DONALD J., Baltimore, Md.
SEIP, NORMAN W., Erie, Pa.
TUPLING, CHARLES G., Portland, Ore.

Transfers from Student Member to Junior 60

Obituaries

Henry Lawson Crain (1906–1952)

HENRY L. CRAIN, superintendent, Hawthorn Station, Kansas City (Mo.) Power and Light Co., died Dec. 21, 1952, while on vacation at Jackson, Miss. Born, Linn Creek, Mo., April 6, 1906. Parents, Green B. and Nora Belle (Laswell) Crain. Education, BS(ME), University of Illinois, 1928. Married Gertrude Ethel McMahon, 1930; children, Joan Marilyn, Robert Edmond (died 1943). He wrote several papers which were published in technical journals. Jun. ASME, 1928; Mem. ASME, 1939. Served the Society as member, Nominating Committee, 1944; chairman, secretary, Kansas City Section.

Henry S. Harris (1882–1952)

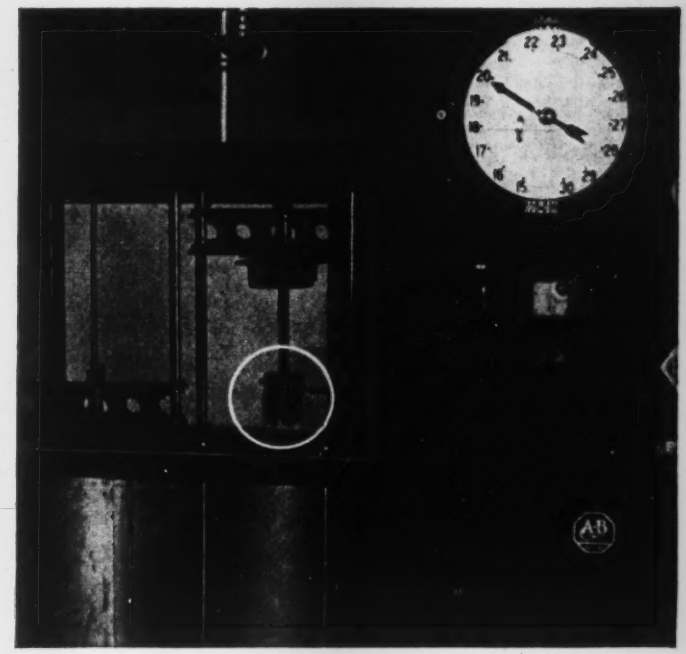
HENRY S. HARRIS, secretary, The Engineers' Club of Philadelphia, died Dec. 21, 1952, at his home in Wyncote, Pa. Born, New York, N. Y., Jan. 16, 1882. Parents, Alfred and Agnes E. Harris. Education, BA, Columbia University, 1902; BS(ChE), The University of Pennsylvania, 1907. Married Margaret Britton, 1912. He was president of the Council of Engineering Societies. He was a former officer of The Franklin Institute of Pennsylvania. Mem. ASME, 1918. Served on all Philadelphia Section committees; chairman, 1926–1927. Survived by wife, a daughter, Mrs. Tessim Zorach; two sons, Britton H., San Juan, P. R.; Alfred H., 2nd, Cambridge, England; and six grandchildren.

Robert Jewell Horn (1895–1952)

ROBERT J. HORN, manager of gas operations, Gas Division, Central Hudson Gas and Electric Corp., Poughkeepsie, N. Y., died Aug. 30, 1952. Born, Bauxite, Ark., June 28, 1895. Parents, Marion J. and Maud A. Horn. Education, BS(ME), University of Arkansas, 1922; MS, Massachusetts Institute of Technology, 1927. Married Mildred Marguerite Coleman, 1921; two sons, Robert J., Jr., Harrison Stratton. Author of many articles on gas production published in technical journals. Jun. ASME, 1922; Assoc. Mem. ASME, 1926; Mem. ASME, 1935.

(*ASME News continued on page 274*)

SCALING RESISTANCE EVALUATED AT HIGH TEMPERATURES



High-Temperature Corrosion Often Is the Main Factor in Metal Failure

Learning why metals fail at high temperatures – determining the actual cause of damage and suggesting as a remedy a more suitable material—these are the jobs of INCO High-Temperature Engineers, who are getting information on such problems for the use of industry.

INCO laboratories in Bayonne, N. J., and Huntington, West Va., have useful data on the properties of metals at elevated temperatures. This information comes from tests made to determine the creep strength, stress-rupture, and other properties of materials at temperatures in some cases up to 2100°F.

Industrial experiences at high temperatures indicate that it is unwise to predict high-temperature performance on the basis of room-temperature properties or short-time high-temperature tests. Other methods have been developed that provide more accurate measures for judging materials.

The machine pictured above was especially designed by INCO Engineers for determining the effect of cyclic heating and cooling on sheet metals while exposed to oxidizing conditions. INCO High-Temperature research likewise covers damage by other corrosive atmospheres. Through work with this and other types of equipment INCO Engineers study the reasons for failure of alloys at high temperatures.

Due to the volume changes accompanying its formation, an oxide film formed at high temperatures on the surface of a metal or alloy is usually under compressive stress. Contraction stresses developed when the underlying metal is cooled further aggravate this situation – and with many alloys may cause rupturing of the normally protective oxide.

Among the factors which influence the resistance to oxidation, the physical characteristics of the formed scale are of importance. The sketches show how these characteristics may cause the breakdown of the scale and thus increase the rate of oxidation.

Blistering may occur in oxide layers having good elasticity but poor adherence to the metal surface.

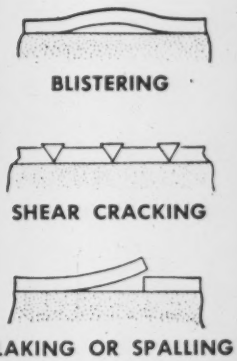
Shear cracking on the other hand will be found in oxides that are adherent but relatively brittle.

Flaking or spalling results when the oxide is both brittle and non-adherent.

As the scale peels away from the metal, it exposes a fresh area to further attack. A point of importance is that the loss of the oxide causes a progressive loss in metal section—useful load-carrying metal.

In high-temperature applications employing sheet or strip, the necessity of obtaining maximum resistance to this form of destruction by selection of a suitable heat-resisting alloy is of greatest importance.

Oxide Scale Breakdown by:



If high-temperature alloy performance is a problem to you, whether in present activities or in new projects, INCO High-Temperature Engineers will do their best to be of help to you. Let them send you the *High-Temperature Work Sheet* . . . it is a big aid in explaining your situation fully. Then see if INCO Engineers cannot help solve your difficulty.

EMBLEM OF SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

Henry Ackley Lardner (1871–1952)

HENRY A. LARDNER, who retired in 1949 after serving as vice-president, J. G. White Engineering Corp., New York, N. Y., since 1913, died Dec. 27, 1952. Born, Oconomowoc, Wis., Oct. 1, 1871. Parents, Richard and Catherine (Breck) Lardner. Education, BS(EE), University of Wisconsin, 1893; EE, 1895. Married Ethel Anne Elmore, 1902. His honors included: Mayor of Montclair, N. J., 1924–1928; past-president, N. J. State League of Municipalities; United Engineering Trustees, 1939–1941. Mem. ASME, 1901; Fellow ASME, 1938. Survived by wife, a son, Richard; a daughter, Dorothy; and four grandchildren.

Llewellyn V. Ludy (1875–1952)

LLEWELLYN V. LUDY, professor emeritus of experimental engineering, Purdue University, died Nov. 8, 1952. Born, Mill Grove, Ind., Jan. 26, 1875. Parents, George W. and Martha Letitia Ludy. Education, BS(ME), Purdue University; M.E., 1896. Married Ruth Henderson Miller, 1929. Author of "The Steam Engine," "Valve Gears," "Locomotive Boilers and Engines," "The Steam and Gas Engines Indicator," and "The Air Brake"; Mechanical Laboratory Notes. Mem. ASME, 1905. Survived by wife.

Daniel Salyer McLaughlin (1921–1952?)

DANIEL S. MCLAUGHLIN, whose death was recently reported to the Society, was a lieutenant, USAF. Born, Dayton, Ohio, Dec. 9, 1921. Education, BS(ME), Purdue University, 1948. Jun. ASME, 1948.

Joseph DeLee McManus (1895–1952)

JOSEPH D. MCMANUS, chief engineer and vice-president, Walworth Co., New York, N. Y., died Dec. 12, 1952, in St. Louis, Mo., while on a business trip. Born, Marlborough, Mass., June 23, 1895. Parents, Joseph B. and Catherine A. McManus. Education, BS, Massachusetts Institute of Technology, 1917. Married Cecilia Dalton, 1926. Assoc-Mem. ASME, 1928; Mem. ASME, 1935. Survived by wife, a daughter, Marilyn P.; a brother, Elmer J.; and a sister, Mary C.

Rolla Leonard Miller (1897–1953)

ROLLA L. MILLER, inspector, Hartford Steam Boiler Inspection and Insurance Co., Los Angeles, Calif., died Jan. 2, 1953. Born, Cottonwood Falls, Kan., Jan. 22, 1897. Parents, William H. and Hattie E. Miller. Education, attended elementary and high schools. Married Clydus A. Wheat, 1919. Jun. ASME, 1937; Mem. ASME, 1941. Survived by wife.

John Cope Pastor (1888–1952?)

JOHN C. PASTOR, owner of the Jacksonville, Fla., firm of John C. Pastor, died Dec. 7, 1952. Born, Harrisburg, Pa., March 17, 1888. Education, special student, University of Michigan, 1920–1924. Author of technical articles published in magazines covering the fields of heating, piping, and ventilation. Mem. ASME, 1943.

Kendall Bailey Rowell (1900–1952)

KENDALL B. ROWELL, chief engineer, American Locomotive Co., died Dec. 12, 1952. Born, Waltham, Mass., March 12, 1900. Parents, Henry K. and May L. (Mitchell) Rowell. Education, Harvard College, 1918–1920; Harvard Engineering School, 1920–1923. Assoc-Mem. ASME, 1930; Mem. ASME, 1935. Survived by wife, Pearl Larsen Rowell; a stepson, Dale A. Schmidt; his mother, three brothers, Herbert, David S., Edwin W.; and a sister, Louise.

Edward A. Uehling (1849–1952)

EDWARD A. UEHLING, inventor and retired industrialist, died Dec. 21, 1952, at West Allis, Wis. His age was 103—the oldest member of The American Society of Mechanical Engineers. He was the founder and former president of the Uehling Instrument Company of Paterson, N. J., manufactures of industrial recording instruments. His inventions included a pig-iron casting machine, a pneumatic pyrometer, and a continuous recorder of the percentage of carbon dioxide in gas. He was credited with having introduced his pig-iron casting machine in the principal European countries. He started the company bearing his name in 1896 and was its president until his retirement in 1919. He was the author of "Heat Loss Analysis," a book, and of many papers in technical publications. Born, Richwood, Wis., June 8, 1849. Parents, Frederick and Anna Margareth (Krug) Uehling. Education, attended Northwestern University; ME, Stevens Institute of Technology, first class in mechanical engineering, 1877; hon. DE, 1921. Married Jeannette Mertz, 1881. Mem. ASME, 1883; Fellow ASME, 1951. Survived by two sons, F. Frederick, Mem. ASME, Passaic, N. J., president of the instrument company, Edward, West Allis, with whom he made his home; and three grandchildren.

Jervis Bennett Webb (1890–1952)

JERVIS B. WEBB, president, Jervis B. Webb Co. and the Huron Forge and Machine Co., both of Detroit, Mich., died Dec. 21, 1952, in his home at Birmingham, Mich. Born, Battle Creek, Mich., April 23, 1890. Parents, Elmer P. and Eudora E. (Wattles) Webb. Education, BME, University of Michigan, 1912. Married Maurene Campbell, 1914. Mem. ASME, 1927. He served the Society as chairman, Executive Committee, Materials Handling Division, for 4 years. He was a pioneer in the development of overhead conveyers for assembly-line production and held nine patents on such devices as trolleys, clamps, overhead loading mechanisms, and an equalizing drive for conveyers. He also was the author of several articles published in technical journals. Survived by wife; two sons, Jervis C., George H.; and a daughter, Mrs. Joyce W. Clark.

Milford Gordon Welsh (1886–1952)

MILFORD G. WELSH, superintendent of distribution, Newport News (Va.) Water Commission, died Dec. 8, 1952, while on a business trip to Richmond. Born, Owensboro, Ky., Dec. 25, 1886. Parents, Milford G. and Ruth T. Welsh. Education, BS(ME), Rose Polytechnic Institute, 1911. Married Ruth Tressel, 1912. Mem. ASME, 1945. Survived by wife and five children, Aileen, Denbigh, Va.; Mrs. E. L. Bryant, Baltimore, Md.; L. H. Welsh, Wilmington, N. C.; F. G. Welsh, Raleigh, N. C.; H. S. Welsh, Covington, Va.

Earl William Zimmerman (1884–1952)

EARL W. ZIMMERMAN, associate engineer, mechanical design section, U. S. Engineers Office, Syracuse, N. Y., died Dec. 15, 1952. Born, Fort Plain, N. Y., Oct. 14, 1884. Parents, Thomas R. and Ada C. (Lipe) Zimmerman. Education, ME, Cornell University, 1907. Married Hazel C. Farmer, 1909 (died 1941); children, William F., Jane Z. Rogers (died 1951). Married 2nd, Maud Fairbanks Byam, 1942. Mem. ASME, 1926. He held a patent on retarding rolls for gravity conveyers. Survived by wife; a son, William F.; two grandchildren, and three sisters.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print — **Check mailing address**

Name ..... (Last — First — Middle)

Home address ..... ☐ (Street — City — Zone — State)

Name of employer .....

Address of employer ..... ☐ (Street — City — Zone — State)

Product or service of company .....

Title of position held .....

Nature of work done .....

Please register me in three Professional Divisions as follows:

1 .....

2 .....

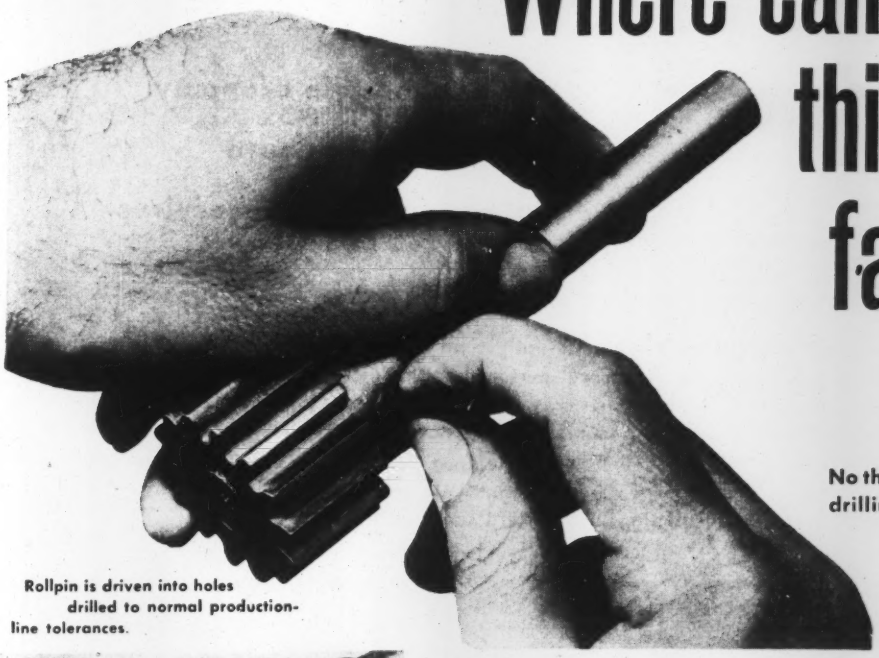
3 .....

(Processing of address change requires four weeks)

I am a subscriber to (please check)

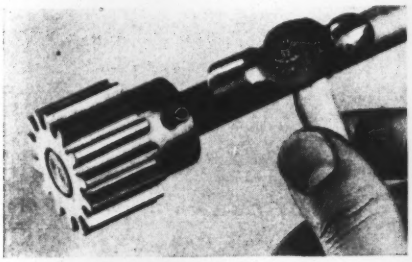
Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐

Where can you use this simple fastener?

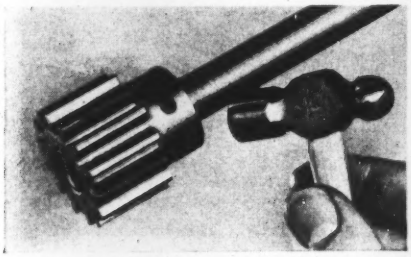


Rollpin is driven into holes drilled to normal production-line tolerances.

No threading, peening or precision drilling with ROLLPIN



It compresses as driven.



Rollpin fits flush . . . is vibration-proof.

Rollpin is the slotted tubular steel pin with chamfered ends that is cutting production and maintenance costs in every class of industry.

This modern fastener drives easily into standard holes, compressing as driven. Its spring action locks it in place—regardless of impact loading, stress reversals or severe vibration. Rollpin is readily removable and can be re-used in the same hole.

* * *

If you use locating dowels, hinge pins, rivets, set screws—or straight, knurled, tapered or cotter type pins—Rollpin can cut your costs. Mail our coupon for design information.

Elastic Stop Nut Corporation of America
Dept. R16-311, 2330 Vauxhall Road, Union, N. J.

Please send me the following free fastening information:

☐ Rollpin bulletin

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☐ Here is a drawing of our product. What fastener would you suggest?

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for dependable economy

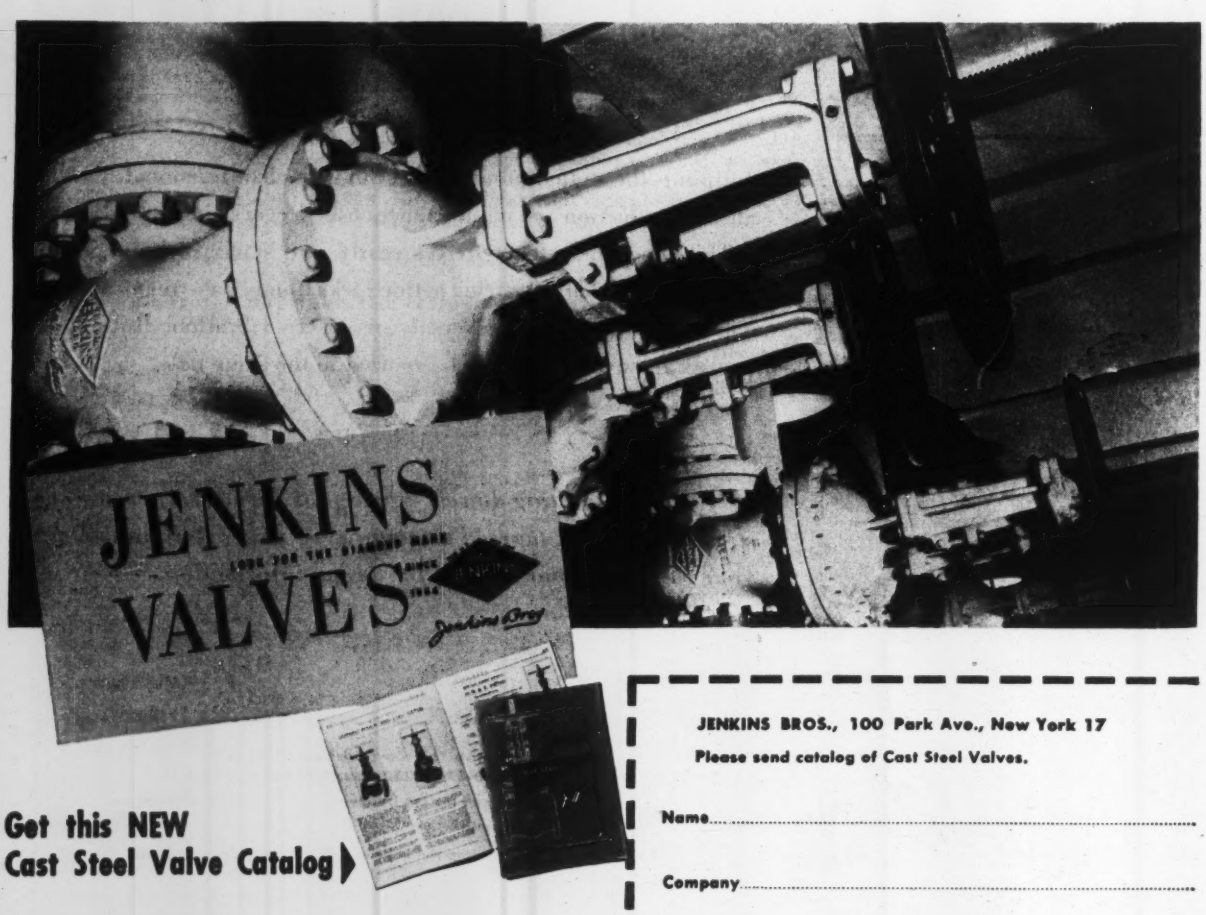
in high pressure

—higher temperature services

Mounting pressures and temperatures in power generation and industrial processing call for Cast Steel Valves. For this increasing need, Jenkins offers a wide selection of patterns that have met the test of the toughest services throughout industry.

In these valves, Jenkins provides a wide margin of strength and safety beyond ratings. Special refinements in design extend their service life, assure long, trouble-free performance. Efficiency and low maintenance records measure up to the high standards established for all valves developed by Jenkins Valve *specialists*.

The new Cast Steel Valve catalog gives complete information. Write for your copy today. Jenkins Bros., 100 Park Ave., New York 17.



Get this NEW Cast Steel Valve Catalog

Describes Globes, Angles, Gates, and Checks with detailed pressure ratings, dimensions, and other technical data covering all patterns of Cast Steel Valves now available from Jenkins. Send the coupon for your copy.

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ANNOUNCEMENTS OBTAINED MOSTLY FROM ADVERTISERS IN MECHANICAL ENGINEERING AND ASME MECHANICAL CATALOG

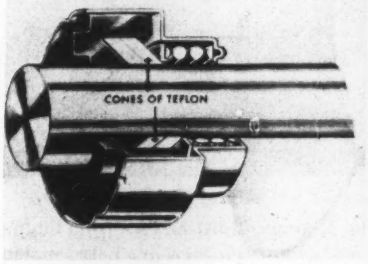
New Equipment *Business Notes* *Latest Catalogs*

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

New Equipment

All-Purpose Mechanical Seal

A new all-purpose mechanical seal has been announced by the Crane Packing Co. Known as the "John Crane" Type 19, the seal is said to provide life-time performance in small pumps, hot water circulators, and many other rotary shaft applications. Special beveled cones made of Teflon (Du-Pont trademark for tetrafluoroethylene resin) are utilized as the flexible member. This adapts the seal for services involving water, oil, corrosives, or acids; temperatures from −100 to +450 F; vacuums and pressures to 200 psi; and high shaft speeds.



Being a package unit, the "John Crane" Type 19 Seal provides quick and easy installation for production assembly and replacement service. It is presently available in sizes to fit shaft diameters of 1/4, 3/8, 1/2, 5/8 and 3/4 in. The metallurgy of the seal, bronze, stainless steel, etc., can be specified to meet service requirements or operating conditions. For further information and engineering data, write to Dept. M-16, Crane Packing Co., 1800 Cuyler Ave., Chicago 13, Ill.

Check Valve

The Waterman Engineering Co. has developed a new check valve for use in oil, air, and water with working pressures to 3000 psi. The body is of one-piece aluminum construction, with a nylon poppet. The valve is available in 3/8, 1/2, 3/4, and 1 in. pipe sizes.

Advantages claimed for the improved construction are lighter weight, leakproof service, and minimum pressure loss at rated flow for a given line size. An illustrated circular is available from the Waterman Engineering Co., 725 Custer Ave., Evanston, Ill.

Drawing-Ink Fountain Pen

A drawing-ink fountain pen with 58 interchangeable nibs is now being offered in this country by John Henschel & Co., Inc., through drawing supply stores. The pen, called the Pelican Graphos, is manufactured in Europe by Günther Wagner. It is light, balanced, and will draw a uniform line from hairline thickness to 3/8 in.

The Graphos will produce well-covered, sharp-edged characters suitable for reproduction, and is ideal for technical drawing, sketching, stenciling, and lettering. As well as the choice of nibs, it offers the advantage of an ink fountain, reducing filling time below that of ordinary drawing pens.

Illustrated booklets may be obtained by writing to the distributor, John Henschel & Co., Inc., 105 E. 29th St., New York 16, N.Y.

Centrifugal Line Purifier

An improved line-type Hi-eF Purifier with increased efficiency and simpler design has been offered for use in cleaning steam, air, gas, and vapor lines. The purifier uses no moving parts or baffle plates, but is designed with a stationary centrifugal separating element.

This centrifugal element gives a rotational movement to the entrainment-laden air. The motion throws all solids and water outward to the walls of the purifier, where they are collected and drained. Increased velocity through the unit improves the efficiency. No appreciable drop in pressure is caused by the separation.

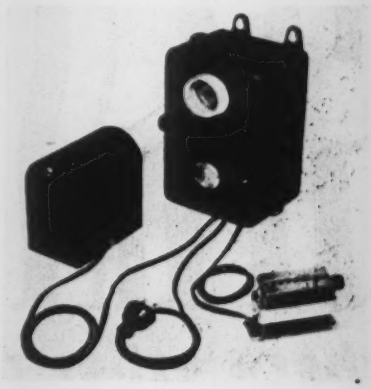
Some applications of the unit are: to clean up steam from boilers to protect reciprocating engines, turbines, superheater tubes, and other equipment; to remove moisture, oil, etc., from gas lines between and after compressor stages; to protect steam ejectors, valves, and other expensive pipeline equipment; to remove entrainment in exhaust steam and vapor applications which attach surfaces when vented to the air; and to clean up exhaust steam for further economic use.

The maker states this simplified but highly effective design enables the Hi-eF Purifiers to be sold at a very favorable price. For instance, a 2 1/2 in. pipe size purifier for 150 psig costs only $155. This line-type purifier is also made in all standard sizes up to 24 in. for pressures up to 600 psig. Except for low-pressure types, all units are designed, built, and stamped to ASME Code for unfired pressure vessels. All units have forged steel flanges with borders of welded steel construction. The units are compact and quickly installed under ordinary conditions. Larger sizes and special designs are also made to specification.

Further information is contained in Bulletin 200, available from the Purifier Division, V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

Photoelectric Counter

Photoswitch, Inc., has introduced a completely packaged general-purpose photoelectric counter, called Photoelectric Counter Set PIC. It consists of a photoelectric control, light source, and electric counter. The only equipment which is located at the point-of-count is the control and light source. One or more electric counters, containing the counter face and reset knob, may be placed at any location and wired to the control, making remote counting possible.



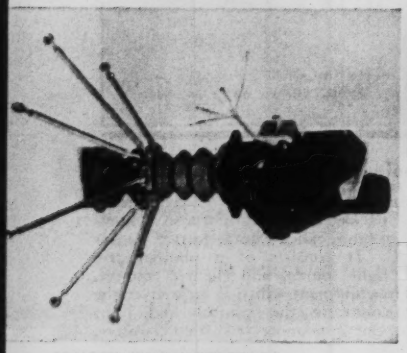
The control has a line cord with a male plug connection for any standard 115-v a-c outlet. The light source and electric counter have cables and plugs for plug-in connection to the control, which supplies their power. Counting speed of up to 600 counts per min is claimed. The operating range is six feet between photoelectric control and light source, but special light sources are available for longer ranges. Further information is available in Bulletin PA506, available from Photoswitch, Inc., 77 Broadway, Cambridge 42, Mass.

Gearmotor

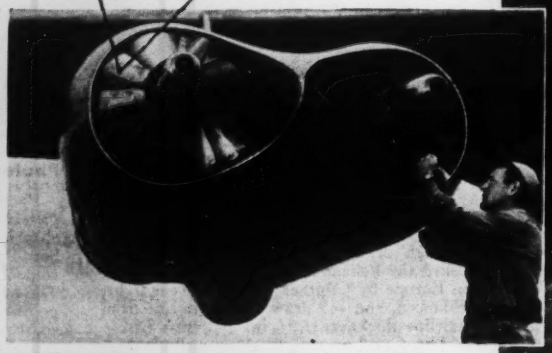
A new Lifeline single-reduction gearmotor (Type B) is available from the Westinghouse Electric Corp. This gearmotor meets the mounting limitation requirements peculiar to side-entry agitators and mixers, and is suitable for light-duty coupled-service applications such as fans and pumps. It is available in ratings from 1 to 30 hp, 780 to 420 rpm, AGMA Classes I and II.

By using reduction gears, gearmotors have the advantage of being able to deliver power at speeds comparable to slow-speed motors while utilizing smaller and more efficient high-speed motors. For further information, write Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30, Pa.

To assure instant operation of jet assist engine air intake doors under icing conditions



COURTESY LEAR INCORPORATED



COURTESY CONSOLIDATED VULTEE AIRCRAFT CORPORATION

SILASTIC

where other materials fail!

Auxiliary jet engines are fitted with aluminum air intake doors which close to reduce drag when not in use, and open when the engines are summoned for extra bursts of power at take off or in flight.

These doors must always respond to the pilot's instant command on the ground, at sub-zero altitudes or under icing conditions.

This requirement was met by embedding heating elements in a piece of Silastic sandwiched between two sheets of aluminum that are shaped to form the door segments. The Silastic insulates the heating element; withstands surface temperatures up to 450°F, and conducts heat rapidly to the aluminum intake doors.

These doors are opened and closed by means of an actuator and screw jack assembly. To prevent dirt and ice from fouling the screw jack, exposed sections are encased in a heat resistant Silastic bellows that retains its flexibility at temperatures down to —100°F.

In designing this anti-icing assembly, Silastic proved to be the only material that remained resilient and serviceable after continuous vibration and repeated exposure to temperatures ranging from —100°F to +450°F.

Such performance is typical of Silastic, the Dow Corning silicone rubber. When you need a material that will remain rubbery and retain its excellent dielectric properties after long exposure to temperatures from below —70° to above 500°F, or after prolonged weathering or contact with a variety of hot oils and chemicals, ***specify Silastic.***

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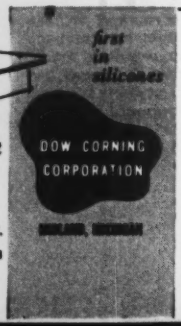
Get the facts about Silastic from your fabricator or write direct



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☐ List of Silastic Fabricators ☐ Silastic Facts 10a ☐ "What's A Silicone?"

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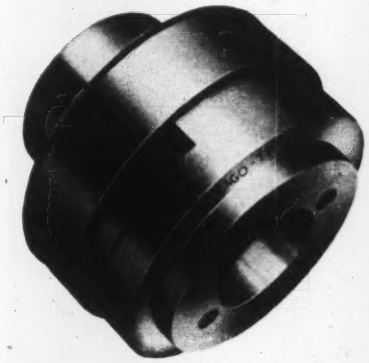
City _____ Zone _____ State _____

Flexible Coupling

A new modification of the Lovejoy Type C Coupling can figuratively be described as one which "crawls into the flywheel." It is a standard Type C Coupling with one hub cut off. Three or more holes are tapped in the remaining flange, by which the coupling is fastened to the center of the flywheel.



Thus by "crawling" into the flywheel itself, this modified coupling saves the space normally taken up by conventional hub-length and affords a cost saving over standard flywheel couplings in the elimination of the flange. In all other respects, including collar, load cushions and inside sleeve, it is identical with the regular Type C Coupling. For complete information, including blue prints, write to the Lovejoy Flexible Coupling Co., 5032 W. Lake St., Chicago 44, Ill.

Constant Support Hangers

Constant support that is mathematically perfect for all positions of travel for high-temperature process and steam piping is supplied by the new Model R Grinnell Constant support hangers. An exclusive feature of their design permits 10 per cent increase or decrease in their load by field adjustment of a single bolt, without impairing their constancy.

This new design results in hangers which are smaller in size for the loads carried. Less head room is required and Model R Constant support hangers can be bolted directly to the building structure and the frames are drilled for either single or double rod suspension. Three regular frame sizes providing maximum travels of 4 in., 8 in., and 12 in. will take care of all loads from 48 lb to 9,304 lb. Grinnell Model R Constant support hangers are non-resonant. With the use of anti-friction needle bearings, friction has been reduced to a minimum. The new design provides favorably small ratios between spring force and the supported load ranging from 1.15 to 1 minimum and 4 to 1 maximum, thereby minimizing bearing stress and prolonging the life of the hanger. Each hanger is individually calibrated before shipment to support the exact load specified. A load scale is provided so that field adjustments of at least plus or minus 10 per cent may be made by turning the single adjusting bolt. Wherever the adjustment is set the Model R gives a load deflection curve that is a straight horizontal line. Further information available from the Grinnell Co., Inc., 260 West Exchange St., Providence 1, R. I.

Air Weight Control Unit

A new compensator, now standard in the model 40 air weight controller for foundry cupolas, eliminates the effects of blower pulsations on control, according to an announcement made by the Foxboro Co., Foxboro, Mass. Uniform combustion through control of air weight is now practical, even where positive displacement blowers are installed on the blast lines.

The function of the compensator in air weight control is to adjust the action of the controller, automatically correcting the rate of air flow for variations in atmospheric temperature and pressure. In the new unit a unique snubbing device also damps out the throbbing effect resulting from the use of certain types of blowers and permits the controller to respond only to true changes.

With the measurement of flow corrected for temperature and pressure effects, the air weight controller positions a valve in the blast line to admit the desired weight of air to the cupola. The instrument provides accurate, sensitive control, characteristic of its performance in more than 1400 existing installations in foundries throughout the world. It is also widely used in a number of other operations, including smelting furnaces, chemical processes, glass melting, and the manufacture of rock wool.

Metals Comparator

Better quality control and reduced testing costs have resulted from the use of an electronic metals comparator at a large Cleveland, Ohio, automotive manufacturing plant.

The metals comparator, a General Electric product designed to detect and indicate variations in hardness of metals by measuring differences in magnetic characteristics, is used to test universal trunnion yoke bearings.

The bearings, used in truck universals, are small cylindrical steel objects in which needle bearings are enclosed. In order to withstand wear, the inside surfaces must be carburized and specially heat-treated.

After the heat-treating, the automobile company runs a 100% inspection on the bearings to assure their being up to uniform standard. This is done, the firm's engineers said, to eliminate bearings that have not been properly hardened due to mechanical irregularities and human error.

Where previously it took three employees working full time to keep the test line moving at the rate of 1000 bearings an hour, now—with the metals comparator—one girl is able to do the job working part time.

The G-E comparator includes an electronic unit mounted in a steel cabinet and a test coil set into a work bench. The dial on the electronic unit is set from a known sample, and then, as each untested bearing comes down the line, it is inserted into the coil. The dial indicates whether or not the part meets specifications.

According to the engineers, use of the metals comparator has reduced testing costs by enabling employees to be transferred to more productive jobs in the plant. In addition, they said, it checks the bearings more efficiently than any method previously tried by the company.

The electronic unit of the comparator includes a balancing network, an oscillator, and an indicator. The equipment operates from single-phase, 60-cycle, 110-volt commercial supply.

This instructive and authoritative booklet will quickly prove itself indispensable wherever bending is done or is needed. It brings you a veritable gold mine of tested authentic bending methods applicable to any rotary type bender. The proper bending technique may frequently offer a new approach to an old problem by simplifying product design and cutting production costs.

The exact methods of producing various types of bends in a wide range of materials are illustrated, step by step, with over 90 diagrams and charts together with valuable tooling suggestions.

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PLEASE SEND 32-PAGE BENDING MANUAL
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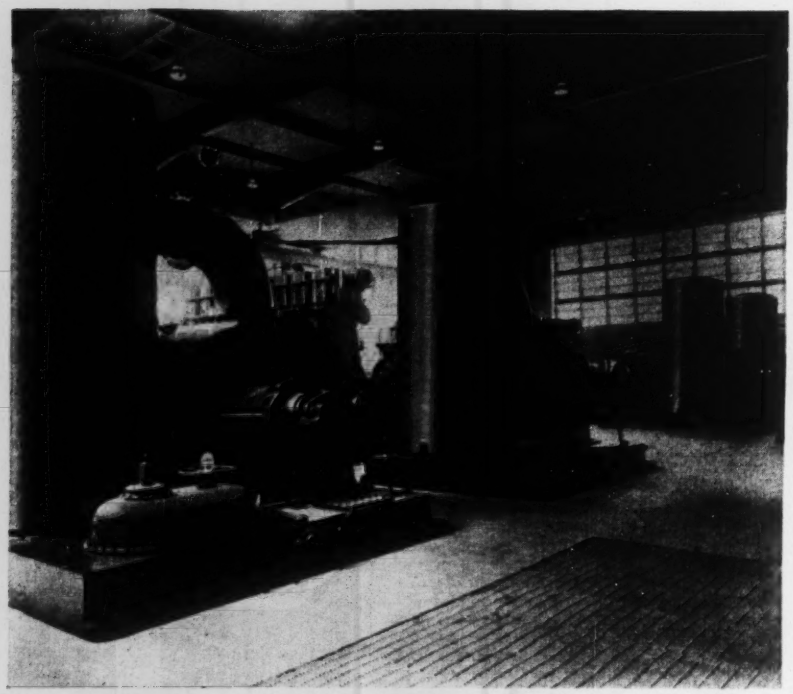

Roots Blowers in Sewage Plant Equipped with Snubbers

Sound Engineering

by

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*Typical Snubber

. . . wherever the flow of AIR, STEAM, and other GASES create N-O-I-S-E.

Standard Snubber* designs are available, incorporating Air Cleaning, Spark Arresting, Water Separation, Waste Heat Recovery, and Surge Control Features.

You can depend upon Burgess-Manning Engineers for a quality product . . . and SOUND ENGINEERING counsel to solve your noise problems.

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LATEST
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Purge Rotameter

A new Purge Rotameter has been announced by Schutte and Koerting Co. This Rotameter is designed for use where small, low-cost flow meters are needed to indicate and manually control small flows of fluids with good reproducibility but moderate actual measuring accuracy.

Typical applications include the indication of: flow of supply air in bubbler type liquid level measuring installations; flow of purge fluid, generally water or air, in the pipelines connecting orifices, venturi tubes, or nozzles to differential head flow meters; flow of transparent purge fluid to sight-glass indicators of Rotameters measuring the flow of opaque fluids; flow of purge fluid to indicator extensions of indicating Rotameters or to extension wells of Rotameters with electric or pneumatic transmitters where the process fluid carries slurries, tends to settle out crystals, or may form surface coatings; flow of sample fluid to measuring installations for continuous chemical analysis of fluids.

SK Purge Rotameters are small-size variable-area type flow meters for low flow ranges. The rate of flow of the fluid passing through the meter is indicated by the position of a ball float moving in the tapered glass meter tube vertically installed in the meter. The rate of flow is read in reference to the center of the ball float on a scale mounted alongside of the meter tube.

A back-flow check valve positively prevents back flow of process fluid into the purged apparatus if the pressure of the process fluid should exceed that of the purge fluid or if the meter tube is removed from the meter body. A flow control valve gives control of fluid flow through the meter over the entire flow range of the meter at differential pressures between 1 to 100 psi across the control valve. A rigid one-piece meter body protects the glass meter tube. The form and appearance of the meter makes it particularly suitable for mounting on instrument panels and in larger instrument cases.

SK Purge Rotameters must be installed in a vertical position.

Complete details on construction, rotor types, flow ranges, pressure drops, and maximum operating pressures and temperatures can be obtained upon request to Schutte and Koerting Co., Dept. M-C, Cornwells Heights, Bucks County, Pa.

High-Temperature Oil

A new lubricant for use at temperatures of 500 F and over, Hi-Temp Oil 303, which is light enough to be fogged easily in automatic lubricators yet provides high load-carrying protection, has been announced by E. F. Houghton & Co., Philadelphia, Pa.

This recently developed "hot-spot" lubricant combines molybdenum disulfide with a synthetic base and a pure, low-carbon-content petroleum oil. Exceptional lubricity, high resistance to heat breakdown, high stability, and reduced carbon build-up on bearings exposed to elevated temperatures are claimed for the lubricant.

Further information on this product and others in Houghton's Hi-Temp Oil series is contained in the recently revised "Hi-Temp Oils" leaflet, available from E. F. Houghton & Co., 303 W. Lehigh Avenue, Philadelphia 33, Pa.

Miniature Thermostat

A miniature Thermoswitch, available in both rectangular and cylindrical models for design convenience, has been announced by Fenwal Inc., Ashland, Mass. Depending on the thermal and electrical characteristics of the particular system, temperature control to within 1 F is attainable, since the inherent thermostat sensitivity is actually less than 1 F. Either model may be set at any temperature in the range from 0 F to 200 F by turning an adjusting screw.

A high resistance to vibration permits the miniature units to maintain accurate control under vibration conditions of 5 G's at 50 to 500 cycles per sec. Both the rectangular and cylindrical models are rated at 2.5 amp at 115 v ac or 2 amp at 28 v dc.

The electrical contacts of both models open when rising temperature reaches the set point. The body dimensions of the rectangular thermostat on the left in the photo are $^{3}/_{4} \times {}^{3}/_{8} \times {}^{11}/_{32}$ in. The cylindrical model in the center has a body diameter of $^{3}/_{4}$ in. and is $^{11}/_{32}$ in. thick. Various types of mountings are available for both models.

Chain Breaking Tool

The Boston Gear Works, Quincy, Mass., announces a new Chain Breaking Tool, CBT60. This tool will disconnect any pitch roller chain manufactured according to the specifications of the American Chain Manufacturers Association from $^{1}/_{4}$ in. pitch up to and including $^{3}/_{4}$ in. pitch. The jaws are of pearlitic malleable iron, heat treated. The pressing tip is of case-hardened tool steel and all other vital parts are heat-treated. The Boston Gear Chain Breaking Tool is $5^{1}/_{2}$ in. in length.

The roller link of the chain to be disconnected is inserted between the jaws of the tool. The adjustable lever is turned, forcing the pressing tip to push the pin through the pin link plate. The process is repeated on the pin at the other end of the same pin link plate, and the chain is then disconnected. For additional information, write the Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

Boiler Level Indicator

A successful plant safety program utilizes every available means to prevent accidents to personnel and equipment. A major safeguard is modern instrumentation, such as the safe and simple liquid level indicator which eliminates a common hazard in the boiler room.

A 12-in. dial indicator, operating on the differential pressure principle, now made by the Foxboro Co., Foxboro, Mass., can be mounted on a panel or pipe standard, bringing the dial to convenient eye level and enabling the operator to be constantly informed of water-level conditions. Large white numerals and micrometer pointer against a dull black dial provide accurate reading even at a distance or in dim light. Readability is unaffected by scale or boiler compound.

The boiler water-level indicator is available in various standard ranges from 0-20 to 0-200 in. of water. The forged-steel body has a rated working pressure of 2000 psi; parts are factory-tested for safety at 4000 psi.

...MEN AT WORK!

Beneath the surface of this undisturbed street in Washington, D. C. men are at work . . . reconditioning water pipelines with the Centriline process. Above ground, traffic flows smoothly . . . unobstructed by the usual men, machinery and excavations.

Because the Centriline process centrifugally applies cement-mortar lining to pipes in place, excavation time, overall costs and interruption to street traffic are kept at an absolute minimum. Couple these advantages with the fact that Centrilining permanently prevents corrosion and tuberculation, increases carrying capacity, reduces pumping costs, gives new pipe service at a fraction of the cost of new pipes, and you have the reason why more and more city engineers and officials are specifying Centriline for their pipeline projects.

CEMENT-MORTAR LININGS FOR PIPES IN POSITION

2,298,688 FEET OF EXPERIENCE

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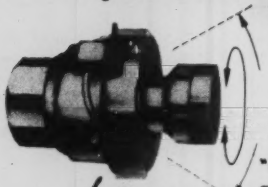
WHEREVER PIPING MUST MOVE

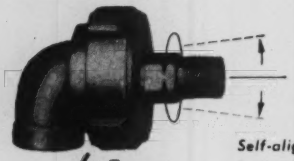
—a specialized BARCO flexible joint!



for angular motion—
—also swivel motion

—BARCO
BALL JOINTS

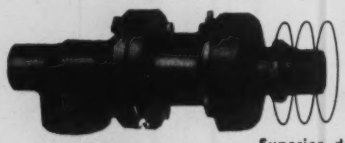
"One joint does the work of two or more!"—because it moves in any direction. Standard the world over where low cost, leakproof movable joints are needed in piping handling steam, air, water, oil, gas, or chemicals. Many models available. Up to 40° side flexibility plus 360° swivel action. Also used to facilitate quick connection of piping, overcome misalignment. Pressures to 7,500 psi; temperatures to 1,000°F. 15 different sizes, ¼" to 12". Ask for Catalog No. 215.



for swivel motion—
—also limited angular motion

—BARCO
SWIVEL JOINTS

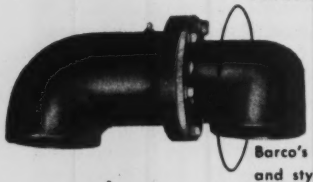
Self-aligning! Exclusive side flexibility (up to 10°) speeds up and facilitates installation; prevents binding. Widely used for making compact, low torque swivel connections to reciprocating or rotating parts on platen presses, tire molds, die casting machines, oil burners. Easy to position piping accurately—no sagging, flopping lines. Leakproof, safe—pressure or vacuum. Ratings as high as 600°F., 3,000 psi (hydraulic). Sizes, ⅜" to 2"; angle or straight. Catalog No. 265.



for continuous rotation—

—BARCO
REVOLVING JOINTS

Superior design insures trouble-free performance, minimum roll drag, and up to 50% power savings. Inherent low torque is little affected by increasing pressure, speed, or temperature. Parts are easily accessable. Light running action minimizes wear, permits free-floating installations. No adjusting necessary—long, leakproof service. Ratings to 250 psi (steam); 450°F. Single flow or syphon styles. Sizes ½" to 2" and special to 5". Wide choice of models. For detailed information, ask for Catalog No. 300.



for swing motion—

—BARCO
SWING JOINTS

Barco's new line of ball bearing Swing Joints is complete with sizes and styles to meet every requirement on loading racks, fueling assemblies, and chemical applications. "O" ring gives long life, leakproof seal. Full bearing surface, swiveling 360° in one plane (single swing) or in two planes (double swing), supports normal piping. Ball bearings can't fall out. Built in steel for pressures to as high as 1500 psi (hydraulic); temperatures, —40° to 225°F. 11 styles: straight, angle, double angle, counter balance. Sizes 2", 2½", 3", 4". Catalog No. 400.

BARCO Manufacturing Co.

5210 Hough St., Barrington, Ill. (A Chicago Suburb)
In Canada: The Holden Co., Ltd.

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Revolving Joints

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

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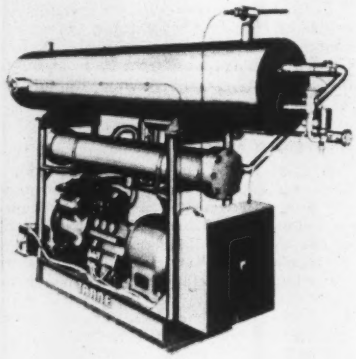
BUSINESS NOTES
LATEST CATALOGS

Packaged Water Chiller

A new "cold-generator", designed to provide a single-unit source of cold water for air-conditioning and refrigerating systems requiring 10 to 50 tons of cooling, was introduced by The Trane Co., La Crosse, Wis., at the 11th International Air Conditioning Exposition, held recently in Chicago. The self-contained unit, according to Trane engineers, requires only simple water and electrical connections to install. Compressor, condenser, liquid cooler, controls, motor, and accessories are combined in the factory-assembled and tested unit.



The cold-generator will be made in 10 sizes, with capacities from approximately 10 to 50 tons of refrigeration. It can be used in both air-conditioning installations and industrial processes. It is suitable for offices, stores, hotels, shopping centers, hospitals, and apartment buildings. Here the varying demands for cooling of different spaces are met by the unit in systems which circulate chilled water in the summer and hot water or steam in the winter to the individual room or zone air-conditioning units.

Package Deaerating Heater

A new development in deaerating heaters for the smaller boiler plants is described in a bulletin which has been prepared by Graver Water Conditioning Co., manufacturers of equipment for all water conditioning processes. This development is a compact "package-type" heater, completely equipped with all accessories including overflow level control, thermometers, relief valve, and vent valve.

The heater is of the highly effective spray-tray type, guaranteed to reduce oxygen in the heated water to 0.005 ml per liter, regardless of fluctuations in the load or the amount of oxygen or other gases initially present in the feedwater. The vent condenser is of the internal type for maximum compactness, and this condenser, together with the self-adjusting spray valves and the tray cubes are of corrosion-resistant stainless steel. These Graver Heaters are built in both vertical type with 2-min storage and horizontal type with 10-min storage, and in standard sizes for capacities up to 100,000 lbs per hr.

Copies of the bulletin describing these heaters in detail can be obtained by addressing Dept. 21-0, Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y., and asking for Bulletin WC-110.

Keep Informed

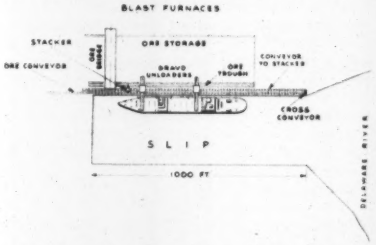
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Unloaders

To unload from ships the basic raw materials for production of steel at United States Steel Company's new Fairless Works near Morrisville, Pa. Dravo Corporation's Engineering Works Div. is building two specially designed unloading structures.

Each unloader is identical in size and can be used to unload either iron ore or coal from vessels docked in a slip off the Delaware River. The structural steel unloaders move on rails alongside the slip. Erection of the structures is being done by American Bridge Division of U. S. Steel Co.

The unloaders each are equipped to handle three sizes of buckets for digging material from the holds of vessels. One bucket is a standard 15-net-ton capacity unit for ore; the second is an auxiliary 7½-ton ore bucket, and the third is a 10-ton coal bucket. The jaws of the largest bucket are 25 ft wide.



Built within the framework of the tower are four receiving hoppers. Two of them, of 101 tons capacity each, are for loading ore into rail cars. The other two feed to conveyer belts, one for coal and the other for ore.

The main tower supports a boom, or apron, that extends over the water 109 ft and carries the bucket trolley and operator's cab. The boom is 69 ft above the yard level. It extends out from the back of the tower 93 ft so that ore may be unloaded and moved to within the operating range of a stockpiling ore bridge behind the unloader.

The tower rides on four electrically driven eight-wheel trucks, one on each corner. Dravo automatic, magnetic rail clamps are installed to hold the tower stationary in high winds by gripping the rails.

Total capacity of the lectric motors that open, close, and lift the buckets, power the tower trucks, rail clamps, trolley, hopper gates, turntable, and boom, is 968½ hp.

To provide clearance for superstructures of ships, the trolley boom is hinged so it can be lifted upwards to an almost vertical position from its normal location at right angle to the tower.

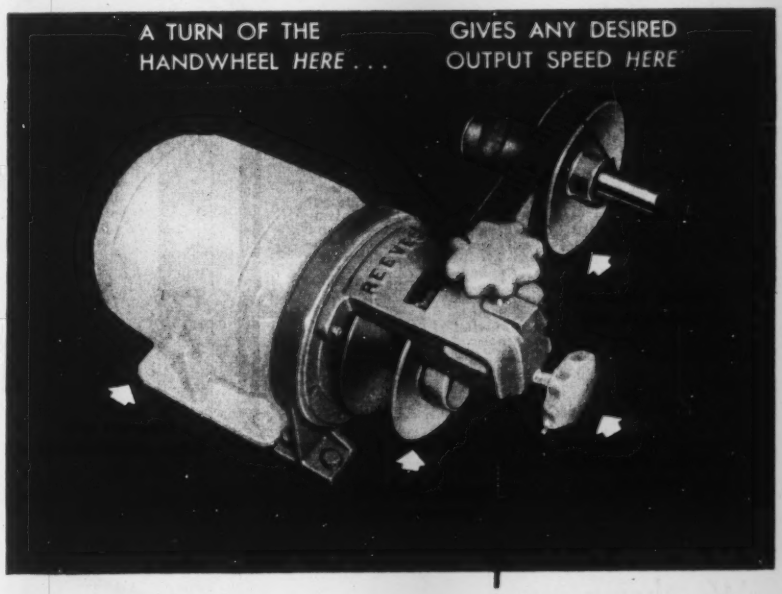
Welded Aluminum Slinger Rings

The Torrington Mfg. Co. reports that their impeller division has begun production of welded aluminum "slinger rings" which adapt all popular sizes of assembled "Airistocrat" fan blades to use as condenser fans for room air conditioners.

Dudley B. Robinson of the Torrington, Conn., firm, states that the company's method of rolling a ring from an aluminum strip permits a wide variety of welded ring diameters and eliminates costly tooling for various sizes. While the rings and aluminum tabs with which they are riveted to the fan blades can be made for any diameter above 10 inches, the rings usually are used with Torrington's 10-, 11-, and 12-inch fans.

NEW! REEVES
Flexi-Speed Drive

Mounts in any position . . . drives in any direction . . . gives any speed within 8:1 range. *Low Price!*



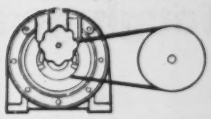
New REEVES Flexi-Speed Drive is the most versatile variable speed drive on the market today. Drives in any direction. Mounts in any position—above, below or beside the driven machine—practically without limitation. Speed control handwheel and driven shaft may be located anywhere around the motor shaft. Six different length belts offer a wide choice of shaft center distances.

For all these reasons, REEVES Flexi-Speed Drive is the easiest, most practical, and economical way of converting any constant speed motor to an infinitely variable speed drive *with 8:1 speed range*. May be used with any standard ball bearing, foot-mounted motor of ½, ¾ or 1 hp. Identical in working principle to the time-tested REEVES Motodrive, the Flexi-Speed Drive consists of constant speed disc assembly, variable speed disc assembly, double-cog belt and versatile shifting mechanism.

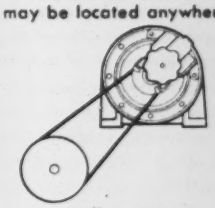
REEVES Flexi-Speed Drive is ideal for driving to standard gear reducers for parallel drive, on worm gear reducer for inexpensive right angle drive. Its versatility assures maximum production with the greatest efficiency and economy in your machines. Write today for complete details. Specify Dept. ME90-V-532.

REEVES PULLEY COMPANY, COLUMBUS, INDIANA

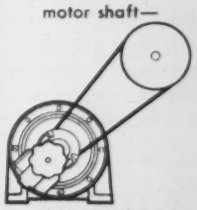
Some of the mounting positions



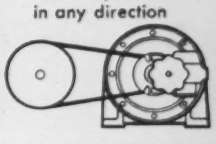
Handwheel control may be located anywhere



360° around motor shaft—

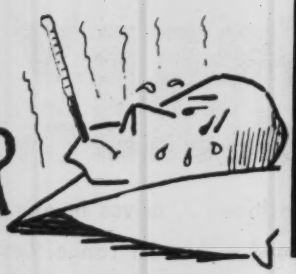


Belt may drive in any direction



REEVES SPEED CONTROL

HIGH FEVER



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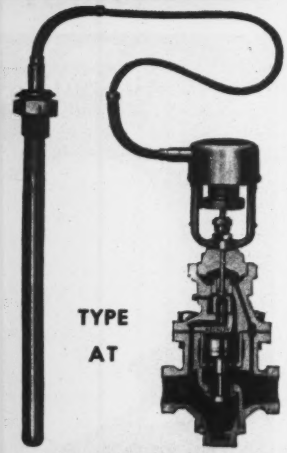
If you're in a feverish sweat because of a tough temperature regulating problem, you can set your mind at ease by standardizing on Keckley. Keckley regulators offer you positive, accurate control of kettles, vats, water heaters, or wherever temperature control is needed. You get extreme sensitivity and wide selection of temperature ranges from —40° to 340° F. No decrease in maximum pressure of 250 psi as size increases. This valve incorporates Keckley's basic Type AA regulator, interchangeable with their pressure, temperature and combination control units for simplified maintenance. Give complete requirements including operating temperature range desired. Check with Keckley today!



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We thrive on

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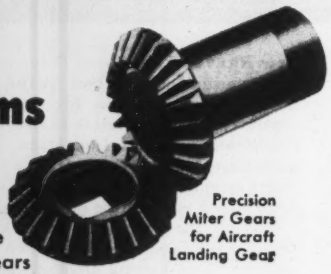

Precision Miter Gears for Aircraft Landing Gear

More and more gear users rely on The Cincinnati Gear Company for their special gear needs, because they've found that we have the "know-how" to produce the *right* gears for their *toughest* requirements every time! And this "know-how" is backed up by the most modern production equipment, complete heat treating facilities, one of the largest shave cutter stocks, electronic inspection when required . . . everything our expert craftsmen need to produce top-quality custom gears consistently, economically.

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NEW EQUIPMENT
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Spark-Fired Gas Engines

Production of a highly efficient series of four-cycle spark-fired gas engines is announced by Nordberg Mfg. Co., Milwaukee 1, Wis. The engines are known as Types FSE-9 and FSE-13, and are built with 9-in. and 13-in. bore sizes respectively in nonsupercharged, supercharged, intercooled-supercharged and Supairthermal types covering a range of 265 to 4260 hp.

Both engines burn natural gas, butane, propane, manufactured gas, and sewage gas. Other gases of lower Btu content can also be used, but at reduced ratings. These engines have the same basic heavy-duty construction features of Nordberg four-cycle diesel engines and where gas is availabe on the seasonable basis, the spark-fired gas engines have the additional advantage of being convertible to 100 per cent fuel oil or Duafuel operation.

Thermal efficiency ranges in excess of 41 per cent with the Supairthermal engine to 38 per cent with the non supercharged engine. This high efficiency in all Nordberg gas-engine types is the direct result of expansion ratios up to 12½ to 1 and controlled air-fuel ratios by variable inlet-valve timing. The correct air-fuel mixture is maintained by the precise timing of the inlet valve. In all Nordberg gas engines, the compression ratio can be selected to any desired value independent of the expansion ratio.

The Nordberg gas engine can be operated without pre-ignition or detonation with a mixture having a small percentage of excess air. Two ignition systems have been employed on these engines. On the FSE-9 engines, a low-voltage impulse-type magneto with distributor, external coils, high-compression shielded spark plugs and low- and high-tension cables are used. One spark plug is used in each cylinder. The ignition system used on the FSE-13 engines consists of an impulse generator, selenium rectifier which generates electrical impulses similar to a half-cycle of a conventional a-c wave, transformer coil, and spark plug resistors. Two spark plugs are used in each cylinder and are mounted in water-cooled holders.

Nordberg FSE-9 and FSE-13 spark-fired gas engines are well-suited for pipeline pumping service, oil refining and production, industrial and municipal power plants, public utilities, sewage plants, oil-well drilling rigs, etc. Several 13-in.-bore six- and eight-cylinder engines are now on order for pipeline pumping service.

Aircraft Motor

To meet the increasing demand for higher horsepower aircraft motors, the Aircraft Division of U. S. Electrical Motors Inc. has added to its already extensive line of aircraft motors a 400-cycle, 3-phase a-c motor rated for 16 hp intermittent duty. Weighing only 28 lb, this motor offers internal gearing for multiplied torque at low speeds. The wide range of gear ratios in U. S. Aircraft Syncrogear Motors permits output shaft speeds from 1500 to 5000 rpm. Designed to meet the requirements of Air Force specification 32590, this unit is designed for such rugged duty as hydraulic pumps, compressors and hoists.

The Syncrogear offers many features including hardened and shaved gears, pyramidal base, integral fan for self-ventilation, AN mounting pad, and internal spline take-off shaft. For further details, write to U. S. Electrical Motors Inc., Aircraft Division, Terminal Annex (Box 2058), Los Angeles 54, California.

Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
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Centrifugal Pump Series

A new series of single-stage, double-suction centrifugal pumps, designated as the Fig. 3405 pumps, with several advances over previous designs, has been announced by Goulds Pumps, Inc., of Seneca Falls, N.Y.

Standard features on all the Fig. 3405 pumps include renewable stuffing-box bushings, sealed bearing housings, cowl-type glands suitable for use with quenching liquids, stainless steel impeller keys, Teflon water-seal rings, die formed stuffing-box packing, and corrosion-resistant gland bolts. The pump casings are horizontally split, and removal of the upper half permits inspection, maintenance, and removal of the entire rotating element without disturbing the suction and discharge piping, or pump and driver alignment.

In the Fig. 3405 line there are three different assemblies of shafts and rotating parts. Interchangeability of parts in each assembly makes it possible to provide 19 different pump sizes in the three groups. In addition, a unique locking design of shaft sleeves makes it possible to change the direction of impeller rotation easily in the field without additional parts. Thus, 38 different pump combinations are offered in the new series.

The pumps can be supplied with electric motor, belt, or steam turbine drives, if desired. The impeller is of the double-suction type, providing hydraulic balance. It is cast in one piece of iron or bronze, depending on requirements. All exterior surfaces are machined, while all interior surfaces of waterways are hand finished. Packed-type stuffing boxes are standard, but mechanical seals of either single or double types can be furnished on order. Motor drive bedplates are standardized, with all bedplates being jig-drilled and tapped to accommodate all motor frames within the scope of the bedplate.

Gland and seal assemblies meet the current strength requirements and specifications of the petroleum refining industry. Bearing housings are completely sealed to exclude moisture and dirt, making the Fig. 3405 pumps suitable for outdoor installations. Water-cooled bearings can be supplied where required.

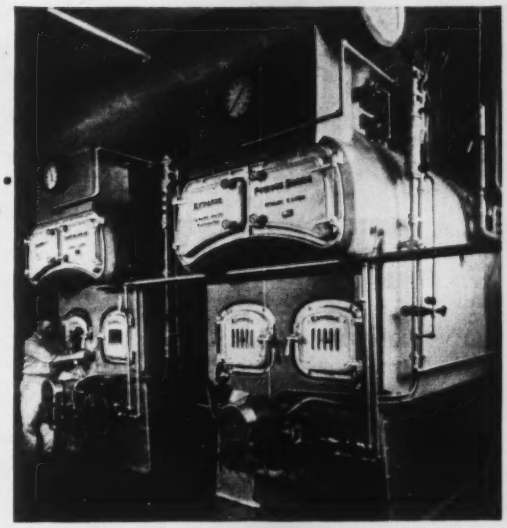
The new Fig. 3405 Goulds pumps have capacities ranging from 200 gpm to 6,400 gpm, with heads up to 260 ft. For additional information write Goulds Pumps, Inc., Dept. ME, Seneca Falls, N.Y., requesting a copy of Bulletin 721.6.

New Stacker

The latest addition to the Powrworker line of Clark Industrial Trucks is the Telescopic Tilting Fork Stacker in four base capacities of 1500 lb, 2000 lb, 2500 lb, and 3000 lb, all rated at 24-in. center line of load.

Two standard models are offered in each capacity incorporating the Hi-Lo Stack feature. One has an 83-in. overall height with 64 in. of free lift and 130 in. maximum lift. The other, especially designed for highway truck loading, has a 68-in. overall height with 49 in. free lift and a maximum lift of 100 in. Lifting speeds vary from 21 to 14 ft per min depending upon load. Big truck performance is claimed for these compact, light-weight Powrworker trucks at minimum cost. For detailed information, write to the Clark Equipment Co., Powrworker Dept., Buchanan, Mich.

MORE ENGINEERING
MORE MATERIAL
MORE EXPERIENCE
MAKE THE DIFFERENCE



KEWANEE

HEAVY-DUTY STEEL BOILERS

There is *more put into* Kewanee Boilers so their owners *get more* from them. There is more engineering, more experience, more steel and labor . . . the very things which insure longer life, unfailing operation and more heat or power from each fuel dollar.

The choice of Kewanee for the Stevens Memorial Hospital . . . selected as the "Hospital of the Month" by Modern Hospital Magazine . . . is in keeping with the trend of specifying Kewanee when dependable, economical heat or power is essential. And, it is significant that this building, erected with the finest materials and equipment throughout, was found in a U. S. Public Health Service study to have the *lowest construction cost per bed* of the 45 hospitals receiving federal aid during the period.

KEWANEE-ROSS CORPORATION
Division of American Radiator & Standard Sanitary Corporation
KEWANEE, ILLINOIS

KEWANEE BOILERS

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Morris, Minnesota
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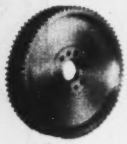
EVERY TYPE OF CUT GEAR FOR EVERY INDUSTRIAL PURPOSE

CONTINUOUS-TOOTH HERRINGBONE GEAR
1" to 60" diameter, 16⅛ DP to 1⅛ DP and up to 20" face.

WORM GEAR
1" to 58" diameter, from 24 DP to 1 DP.

SPUR GEARS
From ¾" to 150" diameter, 32 DP to ¾ DP and up to 30" face.



HELICAL GEARS
From 1" to 72" diameter, 24 DP to 1½ DP and up to 20" face.

BEVEL GEARS
(Straight Tooth)
From 1" to 60" diameter, 24 DP to ¾ DP.

SPIRAL BEVEL GEARS
From 1" to 30" diameter, 24 DP to 1½ DP.

SINCE 1888... We have been making many types and sizes of gears for industry. During these passing years we have derived considerable experience, trained numerous personnel, and expanded our mechanical and plant facilities—and have remained under one continuous management. We are ready to ably serve you.

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NEW EQUIPMENT
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LATEST CATALOGS

Honing Machine

New features have been added to the Model 844 Microflat Microhoning machine by the Micromatic Hone Corp., Detroit 4, Mich. The machine, designed for precision finishing of optically flat surfaces up to 20 in. in diameter, now offers four different speeds in the head, simultaneous changing of spindle and wheel speeds, motorized wheel dresser mounted on machine, control of head oscillation, and pneumatic lift-up of spindle.

Spindle speed may be changed independent of wheel speed by insertion in the head of any one of four worm gears, ranging from single to quadruple thread. Direction of spindle rotation is controlled by a clutch that has three positions, forward, neutral, and reverse. A knob at the lower right rear side of the machine permits changing the spindle and wheel speeds together. The abrasive wheel is geared to the same motor that drives the spindle, so that the speeds of both spindle and wheel can be proportionately changed at the same time by the one control.

The head may be moved without disturbing its previously set oscillating stroke to permit the permanently mounted motorized dresser to swing over the wheel in the dressing position. An air cylinder provides easy lift-up of spindle and attached fixture. An adjustable stop on the quill housing permits repetition of height setting and adjustment for wheel wear when honing a number of identical parts.

"Canned" Motors

Motors being made by Westinghouse Electric Corp. for driving hot-water circulating pumps for a nuclear reactor are, literally, canned. The squirrel-cage rotor is contained in a shrink-fit jacket of steel. It turns within a stator that likewise is fully enclosed in stainless steel. In this type of a motor, the term "air gap" cannot be used as it is a combination of water and two layers of metal. Both the stator and the rotor are encased in stainless steel, and the space between is filled with flowing hot water—the same fluid that is being pumped through the reactor circuit.

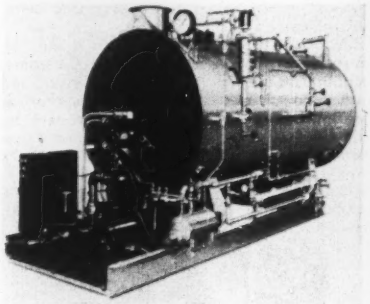
As with most of the components of the reactor circuit, leakage must be small. Hence the motors cannot drive the pumps through seals. The rotor must be contained within the fluid circuit—and obviously is continuously exposed to water that is hot both as to

temperature and radioactivity. To prove tightness, the stator enclosure is tested with the most sensitive leak detector obtainable. The space to be occupied by the rotor is filled with helium under a high pressure and with the stator volume evacuated. The bearings also are inside the stator and are lubricated by water.

The motors are built in several sizes, and the whole packaged unit—motor and pump built integral with it—must pass the Navy test for high shock. One unit is presently undergoing shock tests and has to date survived five blows of relatively severe intensity without any visible or operational damage. A smaller unit has been running for 13,000 hr. continuously (1 1/2 years) under conditions of full load, operating temperature, and pressure.

Fast Boiler Conversion

The Cleaver-Brooks Co., 326 East Keefe Ave., Milwaukee 12, Wis., has announced the development of a faster changeover from gas to oil, or vice versa, in its combination gas- and oil-fired boilers. By turning a selector switch on the control panel to either gas or oil and turning the fuel-supply valves, a complete changeover is effected in a time that the company estimates as 10 sec or less.

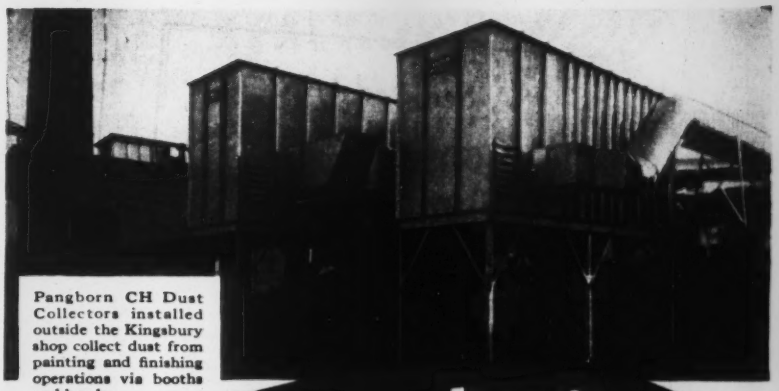


This development is of interest to gas users in areas where local requirements demand quick changeover. The Cleaver-Brooks combination gas- and oil-fired burners now operate on gas with the oil burner in place, eliminating mechanical or electrical change to change fuels. Further information can be obtained by writing the company.

Infrared Ceramic Drying

Faster, more uniform drying of green ceramic dinnerware has been accomplished by replacing an infrared lamp oven section of a convection oven with far-infrared electric radiant heaters, according to an announcement by the Edwin L. Wiegand Co. Mr. Robert Gould, president of Buffalo Pottery, Inc., Buffalo, N.Y., said that various methods of applying convected heat, as well as near-infrared, had been tried, but none was found that could heat the ware fast enough.

The far-infrared radiant heaters provide intense heat for rapid, uniform preheating to release the ware from the mold, and thus prevent warping, distortion, and cracking. Once the critical period of shrinking the ware from the mold has passed, Mr. Gould added, the ware can safely proceed through the convection oven where "by-product" heat from firing kilns effects the major dehydration.



Pangborn CH Dust Collectors installed outside the Kingsbury shop collect dust from painting and finishing operations via booths and hoods.

One Pangborn Installation Solves 6 Dust Control Problems!*

Hoods exhaust dust from hand polishing and grinding booths to outside Collectors

FINISHING operations at Kingsbury Machine Tool Corporation presented a 6-fold dust control problem to Pangborn engineers. Several priming, lacquering and spray painting operations had to be protected from dust created in other finishing jobs such as snagging, grinding and smoothing.

To control these dusts efficiently, Pangborn recommended booths, tables and exhaust hoods. Four main booths, four snagging tables, one snagging bench and a bench grinder hood control the dust at the source. All these are exhausted to two CH Collectors located out-of-doors.

Kingsbury reports the complete system "highly satisfactory"—with these added benefits: Heating costs have been lowered substantially through recirculation of the cleaned air. Costly dust damage to adjacent machinery and products has been prevented. And workers' efficiency has increased due to cleaner working conditions.

What are your Dust Problems? Find out what Pangborn can do to solve them. Write today for Bulletin 909A. Address: PANGBORN CORPORATION, 2200 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

A Selected List of ASME BOOKS for Engineers and Libraries

SHOCK AND VIBRATION INSTRUMENTATION 1952 $3.00

A collection of seven papers dealing with applications of shock and vibration instruments for various services, and problems encountered in their design.

DESIGN DATA 2 VOLUMES 1944

CONTENTS OF VOLUME 1, STRENGTH OF MATERIALS $1.50

Stress and Deflection of Circular Plates. Stress Deflection of Rectangular Plates. Circular Beams Loaded and Normal to the Plane of Curvature. Thermal Stress. Torsional Stresses in Shafts having Grooves or Fillets. Factors of Stress Concentration Photoelastically Determined. Stresses in Pressure Vessels. Press- and Shrink-Fitted Assemblies. Working Stresses. Formulas for Calculating: (1) Load, Deflection, and Stress in Helical Compression and Tension Springs, and (2) for the Design of Piping.

CONTENTS OF VOLUME 2, MECHANICS $1.50

Vibration Problems. Balancing of Rotating Apparatus. Harmonic Coefficients of Engine Torque Curves. Shortening the Time of Applying Theoretical Formulas to Solving the Common Design Problems of Uniform, Flat, and Circular Plates. Result of Calculation for the Deflections and Moments in Rectangular Plates with Hydrostatic Loading. Circular Beams Loaded Normal to the Plane of Curvature. Formulas for Calculating Loads, Rotation, and Deflections of Quarter Bends and Tangents of Pipes.

MODERN REHEAT TURBINES AND BOILERS 1952 $2.00

Aspects of reheating treated include design, progress and service experience; advantages and disadvantages of the reheat cycle; normal start-up, quick start-up, normal operation, and shutdown of modern reheat boilers under normal or emergency conditions; and design factors relating to their performance and operation; special features of operation of several new reheat boilers; conversion to centralize control of auxiliaries; reheat steam temperature control; turbine overspeed control as affected by reheat; and reheat development during the past twenty-five years.

GAS TURBINE PLANT HEAT EXCHANGERS 1951 $3.00

Provides much needed basic heat transfer and flow friction design data for compact heat exchanger surfaces. Included are descriptions of the 34 surfaces considered, test results, dimensions and a scale diagram for each surface, examples of heat exchange performance calculations, etc.

PRINCIPLES OF OPTIMALIZING CONTROL SYSTEMS AND AN APPLICATION TO THE INTERNAL COMBUSTION ENGINE 1951 $2.00

CONTENTS: General Principles of Operating Systems. Methods of Realizing Optimum Performance. General Principles of Optimalizing Control Systems. Sensitivity Signal Input Optimalizing Controllers. Continuous Test Signal Optimalizing Controllers. Output Sampling Optimalizing Controllers. Peak Holding Optimalizing Controllers. Recovery Time of Optimalizing Control Systems. Output Hunting in Optimalizing Controllers with Operating Component Response Delays. Output Hunting Loss. An Experimental Peak Holding Optimalizing Controller for a Reciprocating Internal Combustion Engine. Summary of the Test of the Experimental Controller.

RECOMMENDED PRACTICES FOR CLEANING TURBINE LUBRICATING SYSTEMS 1952 $1.00

Makes available procedures with respect to the preparation of new turbine lubricating systems, the cleaning of lubricating systems after service, and the preparation of turbine oils. Recommendations are based on information furnished by turbine builders, operators, oil suppliers, and consulting engineers.

SMALL PLANT MANAGEMENT 1950 $6.00

This practical Guide to know-how management is based on a study of small plant activities in different industries throughout the country. It thoroughly treats every significant management topic from the principles of scientific management to financing; banking; accounting; legal requirements; taxes; labor relations; unions; plant planning; organizing; operating and controlling; and obtaining best facilities, materials, productivity, and sales.

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The far-infrared section of the oven consists of 18 Chromalox electric radiant heaters mounted at right angles above the conveyer so that uniform heat is applied to dishes that are placed on the belt at random. The heaters were bolted to angle iron and enclosed in sheet metal. Heat was zoned by providing each bank of nine heaters with separate, variable input controllers. Control settings for each size of ware were logged for duplication of heat later.

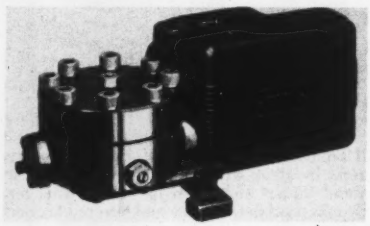
For more information about Chromalox electric radiant heaters and their application, write to Edwin L. Wiegand Co., 7646 Thomas Blvd., Pittsburgh 8, Pa.

Differential Pressure Transmitter

A new differential pressure primary element transmitter for use in automatic control systems is announced by The Swartwout Company, manufacturer of power plant equipment and process control systems.

Known as the Swartwout Type D2T Autronic Differential Pressure Transmitter, the unit is used in conjunction with their Autronic Control System and covers a differential pressure range of 0-20 in. to 0-200 in. water at static pressures up to 1500 psig. Installed at the point of measurement, the unit transmits an electric signal which is directly proportional to the variable being measured.

The manufacturer states that since the Autronic Control System is all-electronic, eliminating electric motors, slide wires, and other contacting mechanisms, response is instantaneous. Furthermore, there are no air lines to leak, corrode, freeze, or cause other maintenance problems.



The Type D2T Autronic Differential Pressure Transmitter has a corrosion-resistant stainless steel diaphragm. Minute movements of the diaphragm are transmitted through a friction-free amplifying linkage to the movable core of the differential transformer which provides the 0.000 to 0.500-volt 60-cycle a-c signal output required for operation of other units in the Autronic Control System.

A feature of the Type D2T Differential Pressure Transmitter is the unique anti-thrust pressure seal which transmits motion of the sensing diaphragm to the signal-generating differential transformer, and acts as a seal against high static pressures.

The unit incorporates a spring for zero adjustment, a linkage-ratio adjustment for coarse span, and an electrical adjustment for fine span which does not affect the zero adjustment.

The unit is extremely compact, measuring only 13 in. long, 6½ in. high, and 5¾ in. deep. Net weight is 26 lb.

Full details on the Swartwout Type D2T Autronic Differential Pressure Transmitter are available on request to The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

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NEW EQUIPMENT
BUSINESS NOTES
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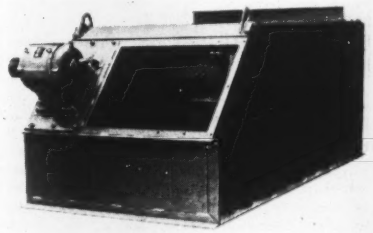
High-Capacity Grizzly

Production of the "Symons" Vibrating Rod Grizzly, a new high-capacity unit designed to scalp in excess of 400 tons of material an hour, is announced by Nordberg Mfg. Co., Milwaukee 1, Wis.

The new grizzly, designated type K-RG, is engineered and built for heavy-duty service in dry, wet, sticky, or gummy rock and ore. Extensive tests have substantiated the high capacity of the unit and several are now in successful operation in the field.

Applicable for separations from 1/2 in. upwards to about 4 in., the "Symons" Rod Grizzly is excellently suited for service following most sizes of primary crushers and for use ahead of secondary crushers. It serves primarily as a single-cut scalping unit; however, it can accomplish a limited number of separations. A large-feed intake opening and ample clearance between the power unit and the screen deck permits an unobstructed flow of material up to 12 in. feed size.



The "Symons" Rod Grizzly is built with a 50 in. wide by 8 ft long screening surface using 1/2 in., 5/8 in. or 3/4 in. spring-steel rods in three bays. The rods, designed for long life, are held in place with a built-in screw clamping device. The rods are easily replaced through inspection and adjustment ports.

The vibrator unit or power mechanism is basically the same type that has been used on other "Symons" vibrating screens. It is located at the discharge end of the grizzly. Motor and drive for the vibrator are installed outside the housing away from the dust. Drive is through a flexible coupling and the pulley runs true, eliminating undue wear on the belts. Positive vibration is achieved by an unbalanced weight. This assures an effective, vigorous vibration which will not dampen out with heavy loads and eliminates over-throw when starting or stopping. The vibrator unit has a wide range of amplitude which can be quickly adjusted to meet specific operating conditions.

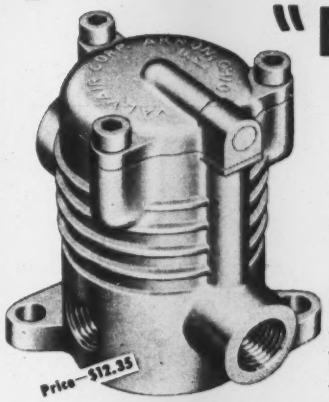
The "Symons" Vibrating Rod Grizzly, weighing 7,500 lb, is 62 in. high at the feed end and 56 in. at the discharge end. It is 12 ft. long and has a width of 68 1/2 in. The unit is furnished complete with V-belt drive and mounts for the 10-hp motor.

Electrode Holder

A 400-amp insulated electrode-holder, the Cooltong, has been announced by The Lincoln Electric Co., Cleveland, Ohio. The Cooltong holder has several patented features which field tests have proved to give longer service life and cooler operation than is normal with holders of similar capacity. It is claimed that in one test made with the holder it remained cool enough to weld with bare hands when using 400 amp current.

GET THE FACTS ON-

VALVAIR'S New "Baby BIG"



SOLENOID PILOT
Air Control VALVE

SMALL ONLY IN SIZE, LARGE EVERY OTHER WAY!

Over 20,000,000 cycles of life may be confidently expected. We believe this valve to be the most rugged ever offered in its class. Valvair's method of sealing prevents wear on seats. Models include 2-way and 3-way either normally open or normally closed. Orifice sizes: 1/16", 3/32", 1/8"; 1/4" pipe tap. Maximum current consumption — 10 watts. For air, water, vacuum, oil or inert gases.

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VALVAIR CORPORATION • Affiliate: Sinclair-Collins Valve Co. 1009 Beardsley Ave., Akron 11, Ohio.

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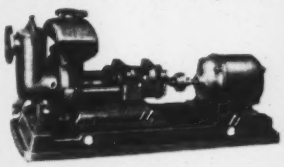
Rely Upon Valvair

A NAGLE PUMP IS THE MAINTENANCE MAN'S BEST FRIEND

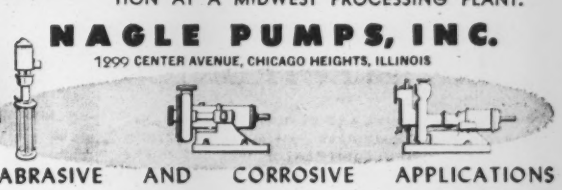
NAGLE Pumps are designed to eliminate shut-downs and maintenance. The 2 1/2" type "AW" self-priming pumps shown feature an easy-to-clean basket strainer, clamp-on quick-off end plate, readily accessible stuffing box, fast sleeve type slippage seal adjustment and split-bearing stand—top half lifts off. Pump can be rapidly dismantled. Variety of drives. Water end parts of the corrosion resistant alloy best suited to your needs. No wonder more and more chemical plants are standardizing on Nagles. A wide range of horizontal and vertical shaft pumps — ALL for corrosive and abrasive applications. Get the facts!



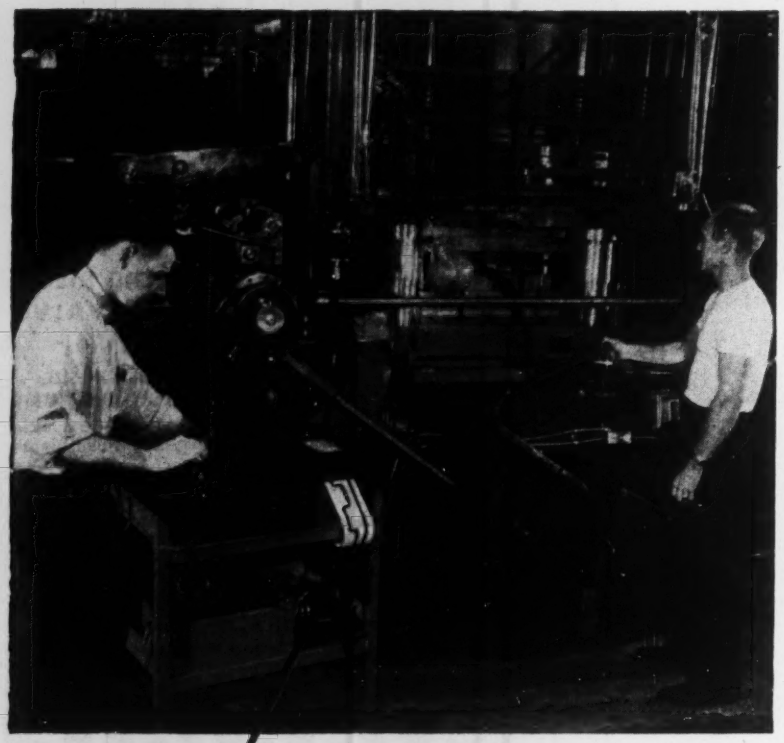
TWO 2 1/2" TYPE "AW" PUMPS, SHOWN ABOVE, ARE HANDLING A CHEMICAL SOLUTION AT A MIDWEST PROCESSING PLANT.

NAGLE PUMPS

NAGLE PUMPS, INC.
1999 CENTER AVENUE, CHICAGO HEIGHTS, ILLINOIS



PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS



CHECKS PRESS LOADING

with Brush Recording Analyzer

Here, in the plant of a large manufacturer of automotive parts, periodic checks are made on this 150-ton mechanical press to spot possible overloading. With resistance-type strain gages mounted on the press, the signal is amplified and recorded by the Brush Strain Analyzer... producing an *immediate chart record* of press strain.

Since measurements can be made quickly and easily, the Brush Strain Analyzer furnishes a *practical method* of detecting overloading and avoiding costly breakdowns, and lengthening press life.

You can use Brush Recording Analyzers to save time and solve problems... in measurement of strain, torque, vibration, pressure, d-c or a-c voltages or currents, and other variables. Brush representatives are located throughout the United States. In Canada: A. C. Wickman, Limited, Toronto. For bulletin write Brush Electronics Company, Dept. P-3, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY

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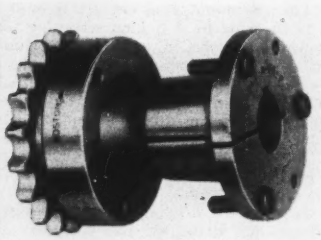
The nose is a special "sandwich" construction consisting of a copper core between four and six layers of laminated, glass-impregnated, plastic cloth. The jaws, covered by this special insulating construction, are made of Mallory 3 Metal, non-spatter type. They will handle electrodes from $^1/_8$ in. to $^4/_{16}$ in. in size and have a wide opening to permit fast release of stubs.

Current-carrying frame parts are made of pure copper for high conductivity. These parts are reinforced with steel to increase the rigidity and strength of the frame. Frame insulation is covered with a copper sheathing to protect insulating part from heat and spatter and to keep the holder cooler by carrying away heat. The holder handle is perforated with large holes to provide superventilation and reduce heating from induced currents when welding with ac. The handle is unbreakable and is easy to hold in any position. The holder is light, perfectly balanced, and completely insulated, and will not break when dropped or otherwise abused.

Split Tapered Bushing

The Boston Gear Works, Quincy, Mass., has announced a new interchangeable split tapered bushing, designed principally for use with sprockets.

This new bushing makes it possible to use the same size Boston sprockets on shafts from $^1/_2$ in. to $2^1/_2$ in. in diameter in steps of $^1/_{16}$ in. This eliminates the need to rebore stock sprockets to fit particular shafts, thus saving the time and cost of reboring, keyseating and tapping for setscrew.



The Shold-a-Grip Bushing is drawn into the tapered hole in the sprocket by tightening cap screws. As both the ID and the OD of the bushing and the bore of the sprocket are ground, the bushing grips both the sprocket and the shaft with the equivalent of a press fit, even on shafts which are undersized as much as 0.005 in.

The mating Shold-a-Grip Sprockets have a shoulder on the hub, allowing room between the teeth and the shoulder for chain clearance. Because the bushing is screwed to the shoulder, and because the diameter of the shoulder is not limited by chain clearance, the Shold-a-Grip Sprocket can be manufactured with a maximum size bore and minimum number of teeth. Shold-a-Grip Sprockets are available from stock in sizes from $^1/_2$ in. pitch up to and including $1^1/_4$ in. pitch. Both bushing and sprocket are of machine steel and can be case hardened. For additional information write to Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

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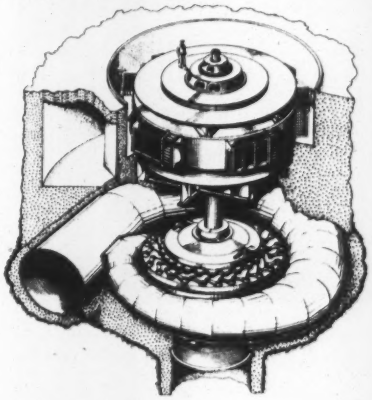
Largest Reversible Pump-Turbine

Contracts for the largest electric motor and reversible pump turbine ever built have been awarded to the Allis-Chalmers Mfg. Co., according to an announcement by R. M. Casper, manager of the firm's power department.

The equipment will be the heart of a pump-storage project at Hiwassee Dam in Southwestern North Carolina on the Tennessee Valley Authority's power network. It is scheduled for completion late in 1955.

In this installation a single hydraulic machine will operate in one direction as a turbine and in the reverse direction as a pump. A direct-connected electrical machine will serve as a motor for pump operation and as a generator for turbine operation.

When in service, water from Hiwassee reservoir, driving the unit as a turbine-generator, will add needed energy to the TVA system in peak demand periods. During off-peak periods, when surplus power is available from other plants, the unit will operate as a motor-driven pump to lift water back into the reservoir. It will act, in other words, as a huge storage battery for storing energy.



The project has many unusual aspects. The reversible pump-turbine will utilize the largest Francis-type runner ever built. As a turbine it will have a maximum rating of 120,000 hp. When motor-driven, the unit will have a pumping capacity of 3.3 billion gal of water per day, or nearly three times as much as New York City requires.

The pump has more than three times the capacity of each of those serving the Grand Coulee irrigation project, which are presently the world's largest.

The electrical motor-generator is equally imposing. As a motor it will be the world's largest, rated 102,000 hp, 106 rpm. It is approximately 50 per cent larger than the motors driving the Grand Coulee pumps. As a generator it is rated 70,000 kva, 13,800 v.

In a normal cycle of operation, the pump will begin lifting water from Apalachia lake into Hiwassee lake under a head of 135 ft at 5200 cu ft per sec. By the time the upper reservoir is filled, the head will increase to 254.5 ft. The rated pumping capacity will be 3900 cu ft per sec against a 205-ft head.

At the beginning of operation as a turbine, the unit will generate 120,000 hp and drop to 36,000 hp as the reservoir approaches the low point. Guaranteed efficiencies are 90 per cent as a pump and 89.5 per cent as a turbine.

keeping fabrics "on the move" in Hunter Piece Dye Machines

WINSMITH SPEED REDUCERS

The large yardage of cottons, rayons, synthetics, woolens or worsteds accommodated by Hunter Piece Dye Machines — in one, continuous operation — involves thousands of dollars per batch.

Should the movement of cloth over the reel be interrupted, allowing the material to remain stationary in the dye liquor for an appreciable time, the ruined fabric would obviously involve a major loss.

As a safeguard against such failure, James Hunter Machine Company, the manufacturer, takes every precaution to insure the dependability of its transmission. The reel which carries the cloth in its Model A and Model S Dye Kettles is motor-driven through a Winsmith Type B, single reduction, worm gear reducer. "The Winsmith Reducer was selected for its dependability," say Hunter engineers. "Our experience with them is such that a change has never been warranted." Likewise, Winsmith reducers are used on Hunter Single Apron Dryers and Sample Dye Kettles.

The advantages of Winsmith Speed Reducers for any applications within the 1/100 to 85 hp range, in ratios from 1.1:1 to 50,000:1, have made them a distinct preference. Make sure *you* are acquainted with the complete, fully standardized Winsmith line of worm, helical and patented differential gear designs. Request Catalog 148.

WINSMITH, INC.
333 June St.
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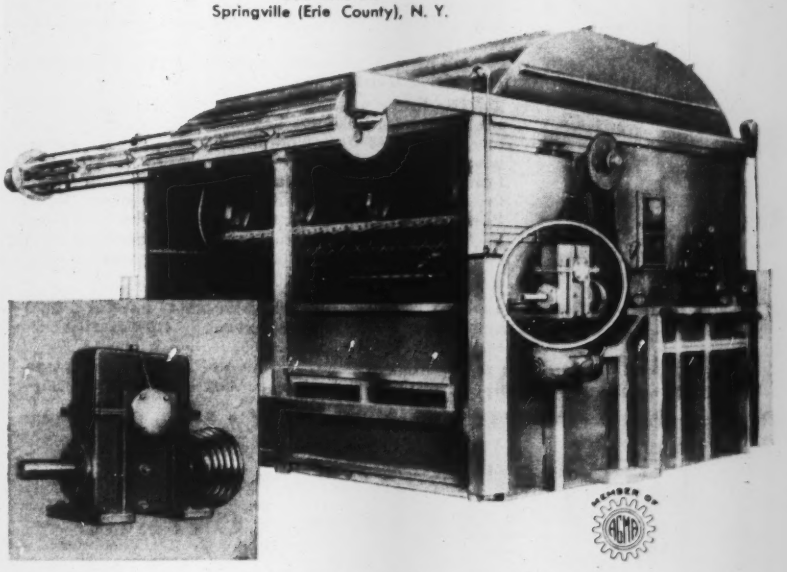
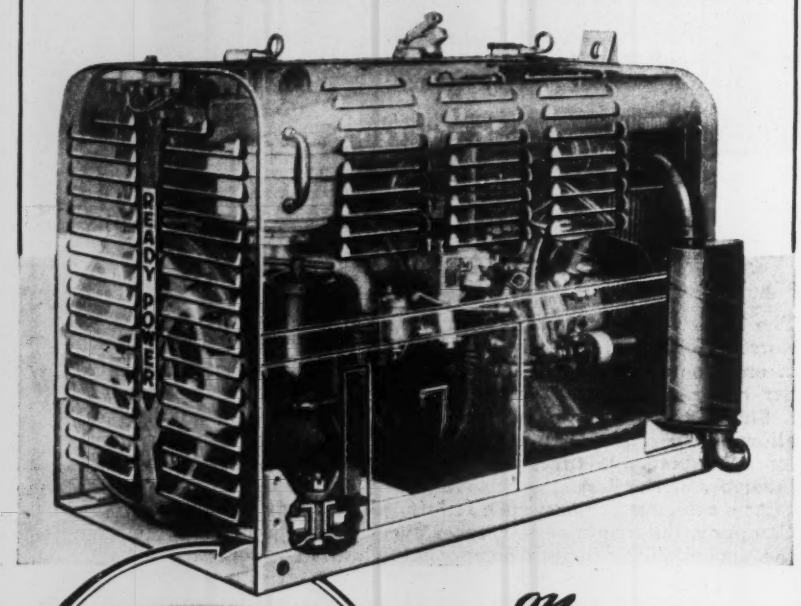


LORD MOUNTINGS
SERVE DUAL PURPOSE



on

THE READY-POWER CO.

"Live Power Units"

LORD Shock Mountings accomplish two vital objectives in the delivery of "Live Power" generated as needed directly on the truck chassis of industrial fork trucks, tractors, cranes and locomotives by Ready Power Units.

FORK

CRANE

FORK

LOW-LIFT

FORK

HI-LIFT

1. The upper Lord Mounting J-4497-2 absorbs the unusually high "g" shock loads encountered in industrial lift truck service . . . At the same time it is rigid enough to prevent excessive engine motion due to these destructive shock loads.

2. The lower member J-4591-1 is a rebound snubbing washer thicker than the sandwich section of the upper member J-4497-2. Precompression thus allows variable bracket thickness of plus or minus 1/16 inch. Thus the Lord Mountings serve the dual purpose of minimizing the vibration and the multiple shocks to which Ready-Power units are subjected in powering the heavy tools of industry. You can profit by Lord experience in the control of vibration and shock. Write or call . . .

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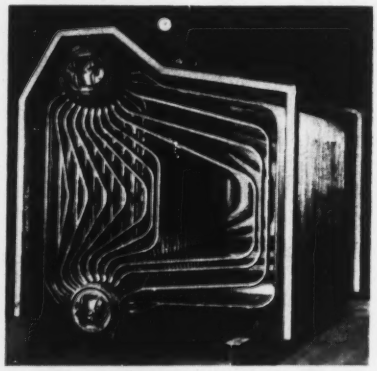
The application of this type of unit is economically feasible and profitable because off-peak power for pumping will cost less and improve the load factor on the system, while the power generated for peak loads will bring in more revenue.

Model tests, standard practice with all new turbine designs, will be made at the company's hydraulic laboratory where they will be witnessed and approved by TVA engineers.

Package Boiler Line

A new standard line of package-type water-tube boilers has been formally announced by the Springfield Boiler Co. The boilers are offered in sizes from 7,500 to 30,000 lb of steam per hr and in design pressures of 200, 300, 600, and 900 psig. All are of a two-drum, bent-tube design with a water-cooled furnace in which tangent water tubes shield the full-length combustion chamber. Provision for superheat up to 200 F is available as auxiliary equipment.



Firing is by oil or gas or combination burners. Units are offered with complete burner and control assembly, or the boiler can be purchased separately. The boilers are enclosed in a gas-tight, insulated steel jacket of special sectional design and are suitable for outdoor, as well as indoor, installation. Units are usually shipped assembled ready for use after making fuel line, water, steam, and electrical connections, but can be shipped in standardized sections for field assembly.

Completely assembled units can be moved easily from one location to another; no special foundations are required because the units are built on a rigid steel frame. Information and literature may be obtained from the Springfield Boiler Co., 1961 E. Capitol Ave., Springfield, Ill.

Roller Gear Drive

The Ferguson Machine & Tool Co., Inc., has recently produced and is marketing the Ferguson Roller Gear Drive, a new type of indexing or intermittent motion mechanism.

Tests have demonstrated that the Roller Gear Drive will operate 8,000 hr (4 shift-years), when extreme precision is required, without maintenance. Where this extreme precision is not required, the drives operate up to 20,000 hr (10 shift-years) without maintenance. Even after such long use, the unit can be renewed merely by replacement of standard ball bearings.

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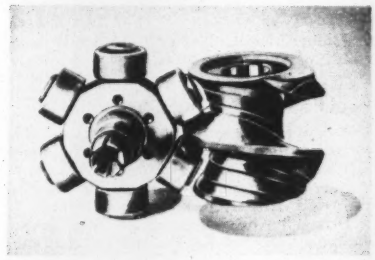
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Designed originally for Ferguson Machine's parent organization, Universal Match Corp., the Roller Gear Drive is now being produced for other companies which previously used Geneva drives and other forms of intermittent motion equipment. The Roller Gear Drive has applications such as use on indexing dials, indexing carriers, indexing conveyers, and indexing mechanisms. It has been used on dials and roll feeds, carrier chains and conveyors at speeds up to 800 pieces per minute to extremely close tolerances and without auxiliary locating mechanisms.



Already standard equipment at various companies, as on V & O Press Company's High Speed Notching Press (see illustration), the Ferguson's Drive can be used for punch-press dials with a precision of plus or minus .001 for 12 in.-diam dials. The Drive has been applied to multi-color printing presses to feed paper webs intermittently at over 10,000 impressions per hour. To take care of either new or existing machinery, the Roller Gear Drives are custom-designed with any number of stops from two to infinity. The indexing period, an entirely separate consideration, may vary from 25 per cent to 100 per cent of the total cycle time—either right- or left-hand rotation is obtainable.

Those interested in further details should contact E. Gordon Reader, Sales and Design Engineer, Roller Gear Div., Ferguson Machine & Tool Co., Inc., 471 Paul Ave., Ferguson 21, Mo.

DEFINITIONS OF OCCUPATIONAL SPECIALTIES IN ENGINEERING

A good book to consult for authorized definitions of approximately 500 occupational specialties in engineering.

Prepared by the ASME with the assistance of representatives of pertinent national engineering societies.

Published, 1951 **$2.50**

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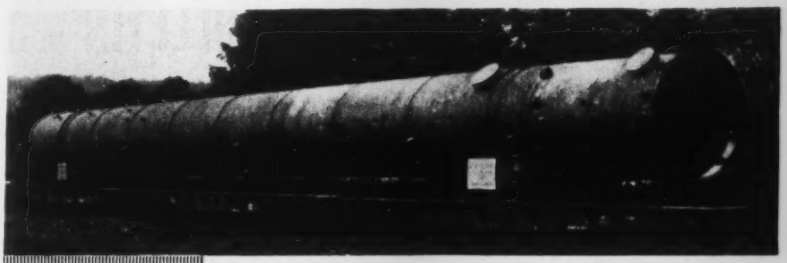
This

STAINLESS CLAD TOWER



diameter 7′ — length 75′
weight approximately 34 tons
stainless clad 20% — type 316

TYPICAL EXAMPLE OF SKILLED PLATE FABRICATION

by DOWNINGTOWN IRON WORKS INC.

. . . yes, DOWNINGTOWN's experience and research in the fabrication of various grades of Carbon Steel, Stainless Steels, Nickel-Clad, Stainless-Clad, Monel-Clad, Cupro-Nickel, Aluminum, etc., may be of help to you. We are equipped with the most modern facilities to handle complete jobs, within our limitations, in the correct alloys and methods of fabrication required to assure maximum operating efficiency.

DOWNINGTOWN also maintains a Heat Transfer Division under the direction and supervision of men thoroughly trained and experienced in this field. Our Engineering Consultation is at your service to aid you in preparation of plans and specifications for definite jobs.

Useful literature sent upon request on your business letterhead. Remember: "Your Needs Are Our Specialty!"

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DIVISION OF PRESSED STEEL TANK COMPANY
Hackney

STEEL AND ALLOY PLATE FABRICATION AND HEAT EXCHANGERS

PUMP *Non-Lubricating* MATERIALS?

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NEW BULLETIN (SE-5)

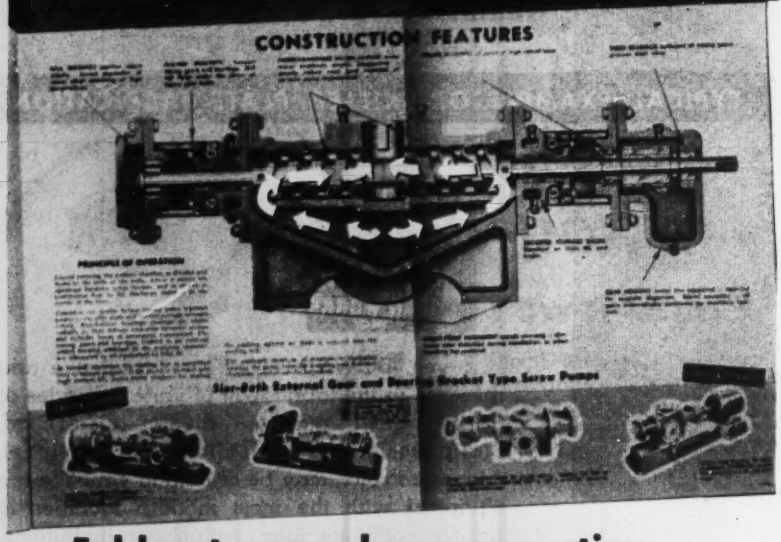
illustrating, describing

Sier-Bath

External Gear & Bearing

Bracket Type

SCREW PUMPS



Fold-out page shows operation... construction details... special types

- **pump fuel oils, crude oils, cellulosics, distillates, etc.**
- **fluids and semi-fluids, 32 SSU to 1,000,000 SSU**
- **capacities 1-700 GPM**
- **discharge 1000 PSI for viscous liquids, 500 PSI for water**

Sier-Bath "Gearex" and "Hydrex" Gear Pumps for lower pressures and capacities

Recently introduced, this Sier-Bath Pump incorporates all the latest refinements of screw pump design . . . and then some. *Center line support* speeds assembly . . . *single point alignment* eliminates rotor distortion . . . *radial and axial* control of rotors by heavy-duty bearings for sustained efficiency, long life. For the *whole* story . . .

SEND FOR BULLETIN SE-5

***Sier-Bath* GEAR & PUMP CO., Inc.**
9256 Hudson Blvd.
North Bergen, N. J.

Founded 1905 **Member A. G. M. A.**

Also Manufacturers of Precision Gears and Flexible Gear Couplings

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BUSINESS NOTES
LATEST CATALOGS

Drawing Board Positioner

Of interest to architects, engineers, draftsmen, and designers, is the new Semco E-Z tilt drawing board positioner that can be used on practically any four-posted adjustable top table. Simple and of metal construction, it requires only 15 min to install. It is possible, through its design, to extend the range of positions of your drawing board from horizontal to an angle of approximately 90 deg thereby reducing fatigue and obtaining the benefits of adequate light on the working area. Its fingertip control makes such adjustments possible in seconds time.

Moderately priced, it is available through Spaulding-Moss Co., 42 Franklin St., Boston, Mass., who are sole distributors.

Fuel Pump

A new tank-mounted turbopump suitable for instantly supplying the extra supply of fuel which jet engines require for reheat operation has been announced by General Electric's Aircraft Gas Turbine Division.

Driven by high-pressure air from the jet engine's compressor, the pump combines boost, high pressure, and vapor separator elements in one package to replace the heavier and more complex line-mounted pump and electrically driven booster-pump combination.

The new pump is designed around the dual-rotor system which involves two separate turbine wheels which have no mechanical interconnection. One turbine drives the vapor separator and the low-pressure boost pump, and the other turbine drives the high-pressure pump element.

One of the outstanding features of the new pump is that there is no mechanical connection with the engine. Only a pneumatic connection is needed, thus leaving an engine-driven gear pad available for other service.

The simplicity of the design makes it unnecessary for the pilot to give the pump any attention. It is turned on or off automatically whenever the afterburner is needed. Unlike a gear-driven pump, the new turbopump can be turned on and off while the engine is operating. This eliminates the recirculation of fuel with its accompanying energy loss and resultant undesirable fuel heating during main engine operation without afterburning. Also, this intermittent operating feature reduces the frequency of overhaul.

Vapor separation in the new pump is achieved effectively by a new method of vapor elimination supplied by Nash Engineering Co. This element permits the pumping of high vapor pressure fuels throughout the range of altitude and climb rates required by our latest designed aircraft. The pump delivers approximately 86 gpm of fuel at a pressure rise of 510 psi.

Only the necessary air connections protrude below the tank as the major portions of the unit are completely immersed in the fuel. Since the pump is mounted inside the tank, no boost is required at the pump fuel inlet.

All necessary cooling is accomplished internally by both fuel and air. The air is drawn into double-walled sections of the pump by a built-in ejector, thus eliminating the need for ram air. The fuel itself provides the necessary lubrication. When all the fuel is consumed, an aerodynamic overspeed control prevents pump damage until the pump is turned off.

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NEW EQUIPMENT
BUSINESS NOTES
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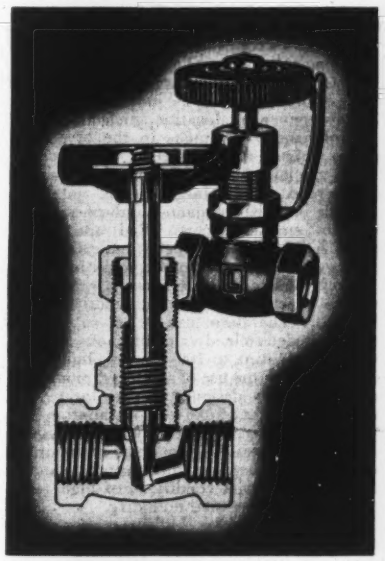
Gland-Type Needle Valve

Introduction of a new gland-type bronze needle valve, has been announced by The Lunkenheimer Co., Cincinnati, Ohio.

The new gland-type bronze needle valve is small and compact, making it ideal for use in pin-point control on small lines where fine regulation of flow is essential. It is manufactured in a full range of sizes from 1/8 to 1-in. and in both globe and angle patterns. The handwheel lends itself to delicate finger-tip control.



This new control valve is also being produced in an indicator model. The globe is available in 1/4, 3/8, and 1/2-in. sizes; and Angle is available in 1/4 and 3/8-in. sizes. The handwheel on the indicator needle valve is of cast bronze and has numbered graduations indicated on its face, permitting resetting to a predetermined degree of opening. A spring clip engaging serrations on the outside of the wheel, holds the valve securely at its proper setting.

Both regular and indicator patterns are made with deep, well-packed stuffing boxes and employ hexagon gland followers.

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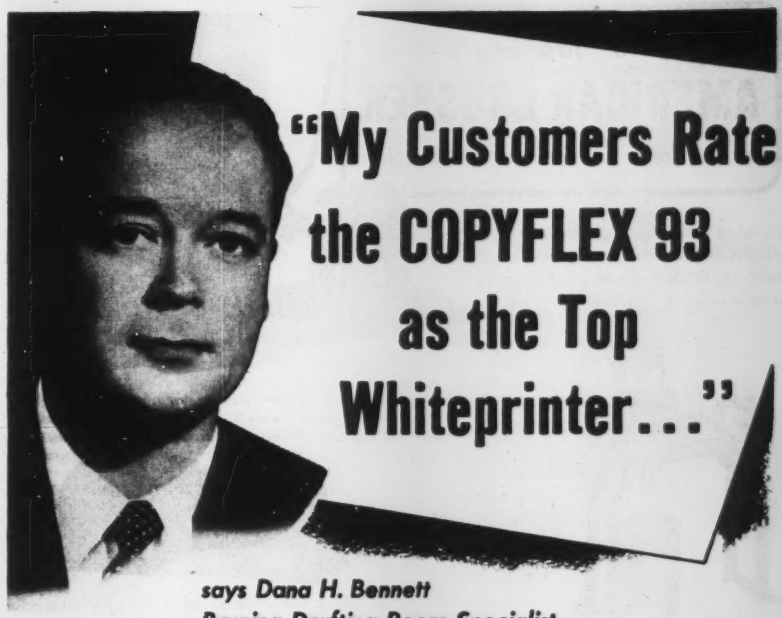

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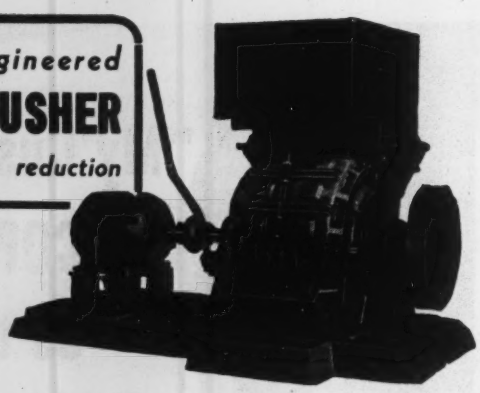

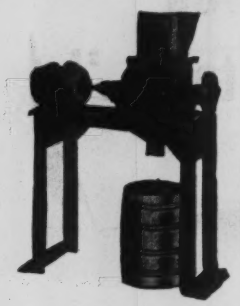

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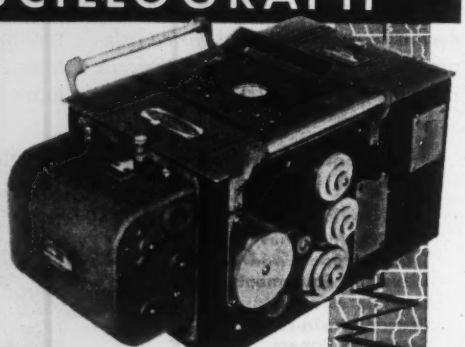

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Smoke Indicator

To assure plant engineers that their plant smoke conditions are within the legal limits established by municipal ordinances, and to provide a simple and direct method of maintaining a continuous check on overall combustion efficiency, Combustion Control Corp. offers the Fireye Photoelectric Smoke Indicator Series FE. Fireye Series FE continuously indicates the density of smoke passing through the stack of a power plant and signals when the smoke density exceeds a preset value.

Fireye Smoke Indicators consist of three basic units: a light source, a photoelectric scanner, and a control and indicator combined in a single housing. The light source and scanner are mounted on opposite sides of the stack or breeching and the indicator is placed at any convenient location, such as on the control panel. As smoke in the breeching passes through the light beam, the indicator shows a smoke density reading which can be easily read on the large $4\frac{1}{2}$-in. indicator scale in both Ringelmann numbers and per cent of smoke density. Red and green jewel lights provide visual indications of excessive or efficient smoke conditions.

Fireye Smoke Indicators incorporate many unique electrical and mechanical design features. The alarm can be set to operate at any predetermined value of smoke density from 10 per cent to 100 per cent light cut-off. Through the use of simplified mounting and a specially designed shutter located in front of the light source lens, installation has been made easier. The equipment is rugged, durable, requires a minimum of maintenance, and has been designed to operate under exacting industrial conditions of high temperature and excessive humidity.

Series FE Smoke Indicators are fully described in Bulletin CM506, obtainable from the Combustion Control Corp., 720 Beacon St., Boston 15, Mass.

Largest Axles

The largest double-reduction hypoid rear axle and the largest double-reduction front driving axle ever built are utilized on the T-10 Transporter used to haul the Army's biggest mobile cannon, a 280-mm gun capable of firing an atomic shell.

Built by The Timken-Detroit Axle Co., these axles help the Transporter carry with the gun a total load of more than 166,500 lb at speeds over the the highway up to 35 miles an hour and up grades as steep as 60 per cent.

The Transporter is composed of two independent 4×4 units which pick up and carry the gun mount, recoil mechanism and rifle between them. They are manufactured by Kenworth Motor Truck Corporation, Seattle. The front unit, as in familiar truck tractors, has its cab forward while the rear unit has the cab at the rear facing forward. Each can operate independently, but when carrying the gun the forward tractor has emergency control of power in both units. The drivers, separated by 80 feet, communicate by telephone.

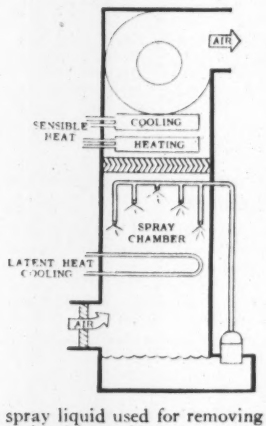
The axles, according to Walter F. Rockwell, president of Timken-Detroit, are "big brothers" of the advanced-design commercial truck axles manufactured by the company. The front axle of both units of the Transporter is a single-speed, double-reduction driving axle and weighs 2715 lb. The first reduction is through a set of spiral bevel gears, while the final reduction is through

spur gears. Power is transmitted through axle shafts and constant velocity Rzeppa joints. The rear driving axle, weighing 3640 lb, is a hypoid bevel gear, single speed, double reduction. The first reduction is through a set of hypoid bevel gears and the final reduction through helical gears.

Although the T-10 has a gross vehicle weight rating of more than 85 tons, as compared with the largest highway truck ratings of about 38 tons, the Army states that the Transporter can negotiate military bridges and be carried in landing ships. Its 84-ft length exceeds by 24 ft the longest conventional truck trailer, yet it can negotiate right-angle turns in streets only 28 ft wide.

Air Conditioning

Niagara Blower Co. New York, N. Y., announces the development of improved apparatus for the drying or moistening of atmospheric air by its new "Liquid Contact Method." Air is treated to fix relative humidity and temperature independently, as separate functions, to obtain closer control of results. Filtered fresh air enters a new type of spray chamber providing especially intimate contact between air and the spray liquid. The spray either adds moisture or removes it by absorption or by condensation. The condition of the spray liquid (its temperature or absorbent concentration) determines the moisture content of the air leaving the chamber. The final temperature is fixed as a separate function, either within the apparatus or external to it, thus giving trustworthy control of room conditions by means of thermostats, without the use of moisture sensitive instruments.



The spray liquid used for removing moisture may be either refrigerated water or the company's "Hygrol," a stable organic absorbent liquid (not a salt) which is automatically held at the proper concentration. When Hygrol is used the latent heat of condensation of the moisture removed may often be absorbed by evaporatively cooled water. The dew point of the air is fixed accurately and final conditions are held automatically constant or varied by either adding or removing moisture in response to changing the instrument setting.

Applications include the establishment of dry atmospheres for protection, processing or drying of moisture sensitive materials, testing materials, and conditioning of air for human welfare. In such comfort-air-conditioning applications the method makes possible the furnishing of large amounts of fresh dry air, with the moisture removed at low cost, permitting the cooling or heating to be done economically with room conditioners of any type with superior results.

Air Impeller

The Torrington Mfg. Co., Torrington, Conn., has announced initial production of a new "LU" series of aluminum one-piece unit-bearing motor fans in three sizes, 7 3/4-, 8 3/4-, and 10-in. diameters.

D. B. Robinson, Torrington vice-president, said the new addition to the company's "Airistocrat" line, designed especially for refrigeration and air conditioning appliances, is hand set to assure accurate forming and blade alignment. Torrington reports that several new customers have adopted the "LU" line for their product. The new series is pierced for all unit-bearing motors.

New Dimetric Paper

A new Dimetric Graph Paper has been prepared by John R. Cassell Co., Inc., 110 W. 42nd St., New York 18, N.Y. The graph lines are drawn at 90°, 39°13′54″ and 11°32′12″ to the horizontal, on translucent vellum, and will not reproduce in blueprints or black-and-white prints.

The new Dimetric paper is part of the Instrumaster line of isometric and dimetric ellipse stencils and accessories, designed for axonometric drawing. A sample sheet is available if requested from the manufacturer on business stationery.

Business Notes

Boiler Water Treatment

The Strong, Carlisle and Hammond Co. of Cleveland, Ohio, identified for over 50 years with Strong steam traps, reducing valves, and steam specialties, has announced its appointment as national distributor for the new Borgana boiler water treatment.

The product was developed over the last ten years by the Chemical Division of The Portland Shingle Co., Portland, Ore. By adding approximately one quart of Borgana per 100 hp per wk, complete boiler treatment is obtained. The existing scale is softened and gradually removed, and further scale formation prevented. It is claimed that Borgana will absorb oxygen and other corrosive gases commonly found in boilers, thereby eliminating corrosion and pitting. It also reduces or eliminates foaming and embrittlement.

Features claimed for the product are the elimination of complicated boiler water tests, simplicity of use, "pre-proved" effectiveness, no danger from over-treating, reduction of corrosion, and the elimination of scale in boilers, traps, and valves. Borgana is non-poisonous so that the steam from treated boilers may be safely used in direct contact with food. In addition to its use in boilers, Borgana also successfully treats cooling water in refrigeration and air conditioning systems, and other units where scale and corrosion difficulties occur. Strong, Carlisle and Hammond plans to appoint some 200 distributors to handle Borgana.

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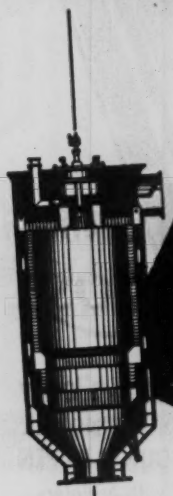

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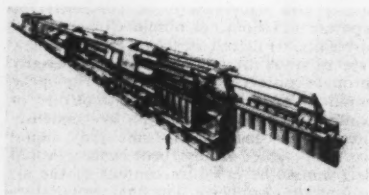
Extrusion Press

The award of a contract for a 20,000-ton extrusion press by the U.S. Air Force has been announced by the Aluminum Company of America. The press will be built at Alcoa's Lafayette, Ind., plant under a lease arrangement.

The 20,000-ton press, in addition to a 14,000-ton press now being installed at the Lafayette plant as part of the government-industry heavy-press program, will produce large extruded shapes for military and civilian aircraft, especially wide, ribbed shapes for integrally stiffened wing panels and heavy shapes for spar caps. In peacetime the press can produce wide, thin shapes for building curtain-wall construction as well as large-size pipe for chemical and petroleum industries. Completion of the press is scheduled for mid-1954. A drawing of the press is shown; the figure of a man, drawn to the same scale, is in the foreground.



To relieve internal strains in the shapes and to straighten them after extrusion, Alcoa has scheduled installation of a 3,000,000-lb stretcher, which will straighten shapes up to 60 sq in. in cross-sectional area in one of the strongest aircraft alloys, 75S.

Maximum weight for extruded shapes from the 20,000-ton press will be 2¼ tons. Maximum length for heat-treated shapes will be set by the existing heat-treating equipment at 90 ft. The new press will be able to extrude ingots 18 to 41 in. in diameter and nearly 8 ft in length.

Results of Koppers Expansion and Development

Production from new and expanded installations and the introduction of new and improved products will considerably enlarge the services of Koppers Co., Inc., to industry and, thus indirectly, to the nation, according to the company.

Full production of ethylbenzene, an intermediate chemical in the production of synthetic rubber and plastics, will be reached early in 1953 at the new Williams plant of the company's Chemical Division near Port Arthur, Texas. From Port Arthur the ethylbenzene will be shipped to the Kobuta, Pa., plant of the Chemical Division for use in making styrene and, in turn, polystyrene plastic molding compounds.

At Fontana, Calif., the new plant of Koppers Tar Products Division in the first quarter will reach full production of coal tar pitch roofing, pitches, and other coal-tar products, in addition to coal-tar-base pipe coatings. This new plant, the largest of its type on the West Coast, will process and refine all of the coal tar obtained from the coke ovens at the local Kaiser Steel Corp. plant.

Substantially expanded facilities at the Kobuta, Pa., plant of the Chemical Division have been completed to utilize the ethylbenzene production from the new Williams plant.

Thermastic Joint Sealing Compound (Jet Fuel Resistant Type) will be available to the military and to civilian air terminal operators to seal joints in concrete runways used by jet aircraft.

Continuous casting of ferrous and nonferrous metals will be more widely accepted during 1953, during which Koppers will design and erect the first continuous casting machine for the production of alloy steel at Welland, Ontario.

Services of Koppers Engineering and Construction Division will be applied to coke and steel plant construction at a continuing high level during 1953 with 918 of 1110 of the oven currently contracted or scheduled for completion during the coming year.

Worthington Oil City Plant

Headquarters for the sales, engineering, and production of Multi-V-Drives and Allspeed Drives have been consolidatd at the Oil City, Pa., plant of Worthington Corp. A new division to be known as the Mechanical Power Transmission Division has been set up to handle Multi-V-Drives, formerly manufactured at Worthington's Buffalo, N. Y., and Wellsville, N. Y., plants, and Allspeed Drives formerly manufactured at Worthington's Holyoke, Mass., plant. Some 150,000 sq ft of manufacturing and warehousing floor space has been allocated to this consolidated operation.

A new green sand department in the foundry is in operation with a capacity of 18 tons of sheave and hub castings per day. Production of the castings at the Oil City plant in conjunction with the machining and processing of these products will result in improved efficiency and handling of customer requirements.

G. E. Expands Silicone Facilities

Expanded facilities for the manufacture of silicone materials to meet increasing industrial demands were put in operation at the General Electric Company's silicone chemical plant in Waterford, N. Y., recently. The Company said that the expansion, costing in excess of $5 million, gives its Chemical Division a silicone production capacity comparable to any in the country. Coincident with the expansion of processing equipment, laboratory services have been doubled and employment is up 50 per cent from a year ago.

The additional capacity it was announced, will help relieve current shortages of many silicone materials for defense and consumer industries.

Among the numerous silicone products and grades being produced by General Electric today are silicone rubber gums and compounds, fluids for automotive and furniture polishes and mold releases, resins for electrical insulation and paint, antifoams for liquid systems, and water repellents for such widely differing materials as masonry and textiles.

The basic operation at Waterford is the combining of stable inorganic silicon metal, derived from sand, with flexible organic materials, using processing equipment as complicated as any in the chemical world, it was explained. By varying the proportions of this "mixture," G.E. chemists are able to turn out scores of seemingly dissimilar products each featuring one or more of the outstanding properties of silicones—resistance to both high and low temperatures, release from sticking, unusual surface properties, and chemical inertness.

THE Con-Wate, manufactured by the Blue M Electric Company is a mechanical convection oven which automatically prevents air anemia by providing constant air weight circulation at temperatures up to 550°F. The constant efficiency of the Con-Wate minimizes test chamber temperature stratification permitting greater specimen test uniformity and longer life of the heater elements. The damper which controls the air flow to the test chamber is actuated by Chace Thermostatic Bimetal.

The Con-Wate damper assembly consists of a curved bimetal element attached to a shaft which passes through the oven wall. Normally, the bimetal element is curved when the oven is not operating; when the oven is turned on, the bimetal damper automatically opens as the temperature rises, thus allowing the blower to deliver more C.F.M. A damper adjustment lever fixed to a friction plate permits the operator to adjust the potential air flow to any desired reduced volume necessary for testing light materials in the oven chamber.

If the actuating element for your new control device is thermostatic bimetal, Chace is equipped and qualified to fabricate it, ready for assembly. Our 29 types of thermostatic bimetal are available in strips, coils, random long lengths and welded or brazed sub-assemblies. Consult our application engineers—recognized authorities on temperature responsive devices—or write for a copy of our 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

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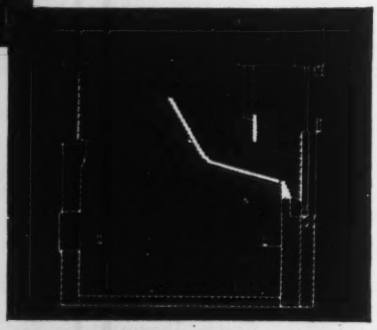
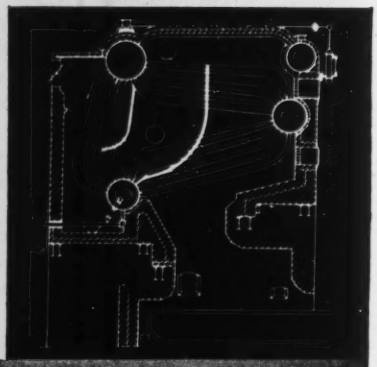
Steam output can be boosted quickly and easily by installing Enco baffles. These streamlined baffles prevent eddy currents and dead gas pockets. The cross-flow puts every square foot of heating surface to work.



Enco baffles reduce draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are more effective and used less often.

Each application is individually designed on the basis of 25 years experience with Enco baffling in all types of water-tube boilers.

Installations are made by skilled mechanics with selected materials.



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Frick Celebrates Centennial

This year, the One Hundredth Anniversary of Frick Co., Waynesboro, Pa., is being celebrated. In preparation of this long-awaited event Frick has published a Centennial History, which covers graphically and pictorially, the highlights during the company's existence.

Chiksan Expands Brea Plant

Expansion of the Chiksan Co. plant in Brea, Calif., is under way to increase office area and warehouse and assembly facilities. A large, modern building will be constructed adjacent to the present main office building. The new structure will have 28,000 sq ft of working area and will consist of a finished material warehouse and assembly section, with an office area to accommodate the Purchasing, Personnel, Cost Accounting, Price Estimating, Production and Material Control, and Sales Development Departments. Included will be a large sales conference room which will also serve as a display room for plant visitors. The new structure will incorporate the latest features of architectural design. The most modern sprinkler and fire protection system will be used throughout.

The addition to the Brea Plant is the latest step in the steady expansion program under way at Chiksan. Production area was increased and additional machinery installed at the Brea plant last year. Similar expansion took place at the Houston plant of Well Equipment Mfg. Corp., a division of Chiksan. The company recently announced that property had been purchased in Brantford, Ontario, Canada to be used as a site for a new manufacturing plant. The new Canadian subsidiary will operate under the name of Chiksan of Canada, Ltd.

New Link-Belt Colmar Plant is Opened

Manufacture of custom-designed conveying and processing machinery has been put on a straight-line production basis in the new 300,000-sq ft plant, designed and built for Link-Belt Co. by the Austin Co. at Colmar, Pa., 25 miles north of Philadelphia. The Colmar plant is Link-Belt Company's 17th.

Production is already under way on elements for a Venezuelan iron ore-handling system that will unload, crush, screen, and store the ore at the rate of 6000 long tons per hour—100 tons per min.

The Colmar plant is of modern design, with large, uncrowded work areas. It combines straight-line production with utmost flexibility. Changes in layout can be made to suit a wide variety of products.

The plant is 880 ft long, 300 ft wide, with a two-story office building.

Craneways in four of five 60-ft production bays, with 32-ft clearances below trusses, extend under still higher transverse craneways in the receiving and shipping cross bays at either end.

The layout, designed for an ultimate expansion to double the present manufacturing area, provides a plant with separate offices and toilet facilities, and an office building complete with all necessary facilities, including a cafeteria and medical dispensary.

The project also includes a complete sewage treatment plant, at the rear of the building site, with primary and secondary settling tanks and bio-filters. This equipment is manufactured by Link-Belt, and so it also serves as a laboratory and demonstration unit.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Trane to Build Weather Lab

A million dollar "House of Weather Magic" is being built by the Trane Co., at La Crosse, Wis. The new research and testing laboratory will include facilities for duplicating temperature, humidity, pressure, and air movement conditions anywhere on the globe, from equatorial mines to arctic flights. It will probably be the largest in the world devoted primarily to the science of heat exchange—which is fundamental to air conditioning, heating, and a host of chemical, drug, and industrial processes. The laboratory will triple the company's research facilities. In the new laboratory Trane engineers will intensify basic research and expand product development and testing of equipment affecting almost every phase of human comfort and production.

Alcoa Announces Expansion Plans

Plans for a proposed major addition to Aluminum Ore Co.'s new alumina works at Bauxite, Ark., were announced recently.

At Rockdale, Texas, the nation's newest aluminum smelting plant, Aluminum Company of America's Rockdale Works, began production recently as aluminum was poured from the first operating potline.

The new Alcoa plant, which will have a capacity to produce about 170 million lb of aluminum annually, will be the first aluminum smelting plant in the nation to use electric power generated by burning lignite.

Alcoa also announced plans to build a modern new fabricating plant in the Lancaster, Pa., area for production of aluminum screw-machine products, fasteners, rivets, and nails.

Alcoa's production of screw-machine products, fasteners, rivets and nails—vital for both defense and civilian uses—now comes from a section of its Edgewater, N. J., plant.

The operations to be relocated in Lancaster would make room for a planned expansion of Edgewater's aluminum sheet, impact extrusion, and foil production facilities.

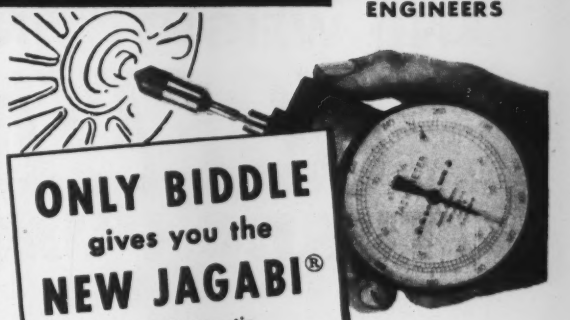
New Engineering Building Opened at Edward Valves

East Chicago, Indiana, Jan. 9—An attractive new two story modernistic structure built almost entirely of stainless steel and glass has been erected by Edward Valves, Inc., East Chicago, Ind. The new building, located next to the Edward Laboratory and Research Building, was built for Edward's engineering department and has been specially designed for their use. For example, its entire north wall is composed of plate glass windows with stainless-steel trim allowing maximum use of natural north light. Four fifths of the building area is devoted to a giant drafting room, lighted by the above mentioned windows and 12-ft windows on the building's west wall, supplemented by a carefully designed fluorescent lighting system. The location of this new building adjacent to Edward's Research Laboratories, was designed to make liaison between the two departments as simple and convenient as possible. This arrangement permits continual consultation between engineers working with specific design problems and laboratory research scientists who study basic characteristics of various valve constructions and materials.

Tips on TACHOMETERS for MECHANICAL ENGINEERS

Longer Instrument Life Lower Repair Bills

New models AO and DO Jagabi Hand Tachometers with "Overspeed Protection" are exclusive with James G. Biddle Co. These highly accurate and always reliable instruments are equipped with a special friction coupling that minimizes the damaging abuse of occasional overspeeding and too-sudden acceleration if accidentally used at too-low range setting. This protection is also available in the Jagabi Tachograph.



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SPEED MEASURING BULLETIN. A selection chart of Speed Measuring Instruments for specific conditions is a feature of BULLETIN 35-ME.

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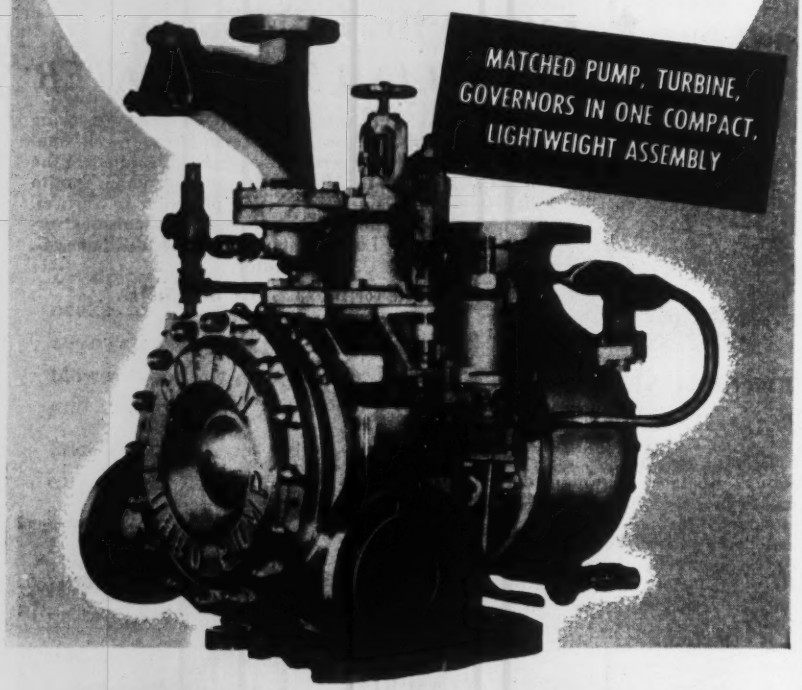

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New Rust-Oleum Distributor

The Rust-Oleum Corp., 2799 Oakton St., Evanston, Ill., leading manufacturer of rust-preventatives for over 25 years, recently appointed The Industrial and Farm Equipment Corp. to its farm and industrial distributors.

Located at 3100 W. 4th St., Chester, Pa. The Industrial and Farm Equipment Corp. will carry Rust-Oleum's complete line of farm and industrial protective coatings.

Consolidates Equip. Corp. Acquires New Department

Formal acquisition of the vacuum equipment department of Eastman Kodak's Distillation Products Industries of Rochester N. Y., by Consolidated Engineering Corp. Pasadena, Calif., was announced recently.

The new company will operate under the name of Consolidated Vacuum Corp., a wholly owned subsidiary of Consolidated Engineering Corp. Steps are now underway to secure permanent facilities for the new company in the Rochester area.

Consolidated Vacuum Corp. will continue to manufacture the line of DPI high-vacuum equipment and complete high-vacuum systems as well as the complementary line of valves, gages, pumps, and pump oil.

Vickers Expands Hydraulic Production

Manufacturing facilities of Vickers Inc. have been expanded with the addition of a plant at Joplin, Mo., having over 100,000 sq ft of floor space. The new plant, which began production of aircraft components about August 1, provides greatly increased manufacturing facilities for Vicker's extensive line of hydraulic pumps, motors, accumulators, and power transmissions supplied to the aviation industry. Manufacture of aircraft hydraulics for both military and commercial use will also continue at Vicker's plant in Detroit.

The Joplin site was selected in an effort to comply with the decentralization policy prescribed by the military services for suppliers of proprietary equipment. The plant's geographic location also brings it closer to Vicker's airframe customers on the West Coast and in the Midcontinent.

ACL Uses Timken

The Timken Roller Bearing Co. has announced that the Atlantic Coast Line Railroad has specified that Timken journal bearings be used in the construction of 2,000 new freight train cars to be built for that railroad. Already in operation on the Atlantic Coast Line are 946 pulpwood and covered-hopper cars equipped with Timken bearings. A total of 32,000 tapered roller bearings will be used on this new order in the 800 fifty-ton pulpwood cars and 1,200 seventy-ton covered-hopper cars. These cars will be built by the Bethlehem Steel Corp., The Pullman Standard Car Mfg. Co. and The American Car and Foundry Co. With the completion of these 2,000 new freight cars, Atlantic Coast Line will have in operation on its lines 2,946 Timken roller-bearing-equipped cars, more than any other railroad in this country. Work on the bearings for the Atlantic Coast Line will get under way immediately at the Canton plant of The Timken Roller Bearing Co.

Keep Informed

NEW EQUIPMENT
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New Ric-wiL Office

The Ric-wiL Company manufacturers of conduit systems, for steam oil, or hot water pipes, has opened a new branch in New York City, located at 215 East 37th St. John F. Hanbury, former New York district representative for the Warren Webster & Co. and The Ric-wiL Company, is manager of the new Ric-wiL office, with Carl G. Mencke assistant manager.

Warren Webster & Co. will continue its office at 95 Madison Ave., New York, with Kenneth C. Steeneck as its new district representative.

G. E. Building New Plant in Philadelphia

Construction has begun on the new G.E. Service Shop and Warehouse in Philadelphia, Pa. Designed by the Kuljian Corp. in collaboration with General Electric engineers, the one-floor operation of the new 3-acre plant will make for increased efficiency.

To accommodate turbine generator fields weighing up to 50 tons, large synchronous motors and generators, as well as other heavy electric equipment, the Service Shop has been designed with a high bay which bisects the shop area and permits the four major service departments to front on the high bay.

The machine shop will render all major mechanical repair required by equipment being serviced in the plant--including such operations as welding, brazing, machining, realigning of precision equipment, and dynamic balancing of rotating elements.

The warehouse will stock a greater variety of products such as motors, controllers, instruments, and other standard General Electric apparatus for off-the-shelf delivery.

Latest Catalogs

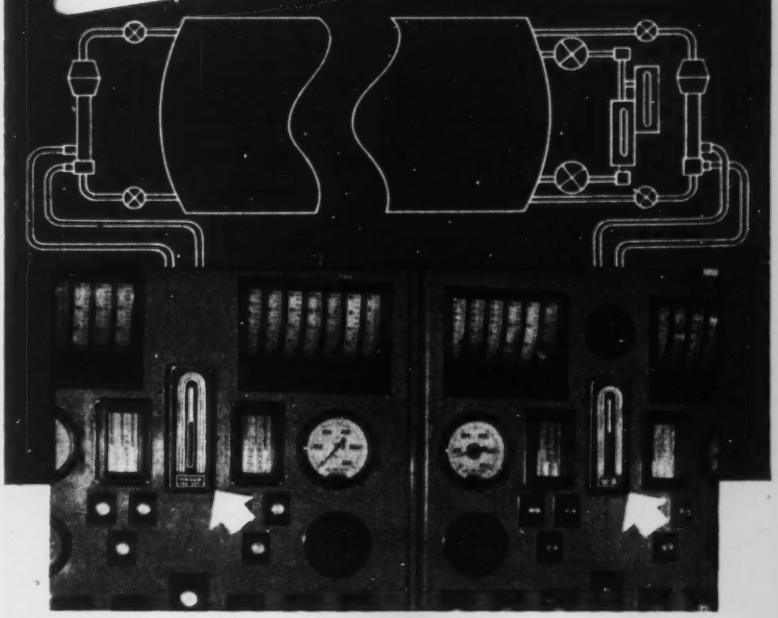
Dual Stage Burner

The development of a new dual stage burner combining steam and mechanical atomization, by the National Airoil Burner Co., Philadelphia, Pa., is described in bulletin 250. Tested in the power, petroleum, and chemical industries, the burner is said to have the inherent advantages of both systems of atomization. Oil entering the burner is first mechanically atomized in an internal swirl chamber. After leaving the mechanical stage, the partially atomized fuel is sprayed into a mixing chamber where it is further atomized by steam. Capacities from 80 to 300 gph have been obtained.

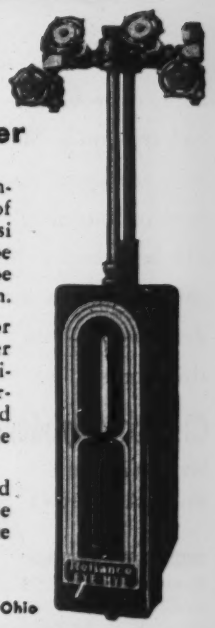
Nylon Plastic Parts

A 4-page illustrated bulletin, No. CDP-654, describing G-E custom molded nylon plastics parts has been issued by the General Electric Company's Chemical Division in Pittsfield, Mass. Suggesting many mechanical applications and design possibilities, the booklet pictures more than 20 of the many nylon parts currently molded by G. E. Ample text describes nylon's strength, lightweight, self-lubrication, and other advantages that can result in cost savings compared with conventional materials. Tables are included showing mechanical, thermal, electrical, and other properties of molded nylon plastics.

Latest boiler code provision permits new water gage facility on high pressure boilers



Now two EYE-HYE Remote Gages give you the required double check on pressures 900 lbs and over



Two independent remote level indicators of the compensated manometric type may now be used instead of one of two gage glasses required on pressures 900 psi and over. You still must have one conventional type gage, maintained in serviceable condition, but it may be shut off while both remote indicators are in operation.

This is a tremendous advantage. It removes the need for checking high gages, maintaining mirrors or other water level reading methods. EYE-HYE's sharp, illuminated indication is frequently reported as more accurate than gages at the drum. Now the two gages required can be at eye height—convenient, safe—a true double check on the vital boiler water level.

For full details of the new code interpretation read Case No. 1155. For information about Reliance EYE-HYE, call your Reliance representative or write for Bulletin CO.

The Reliance Gauge Column Co. 5902 Carnegie Ave., Cleveland 3, Ohio

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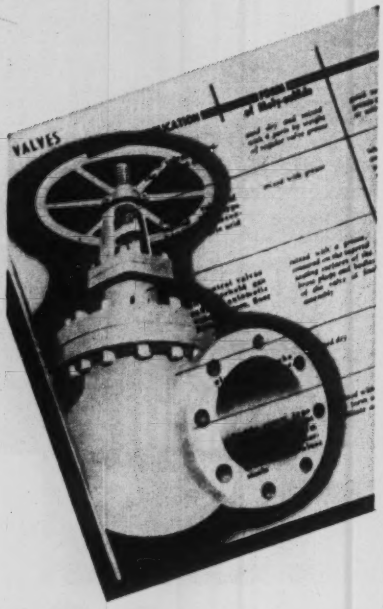

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Carbide Dies

A new 30-page catalog, D-130, describing a complete line of carbide dies has been prepared by the Carboloy Dept. of General Electric Co., Detroit, Mich. The catalog includes a new list of header die nibs and special information on wire flattening rolls, welding rod coating dies, and capstan rings. The contents also include: round hole dies, shape dies, mandrels, standard wire die bushings, guide rings, extrusion dies, large draw dies, blanking dies, typical die room equipment, die-room accessories and supplies.

Control Centers

A new 31-page application booklet, No. B-5621, on control centers is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Stressing the case for centralizing all controls of an entire system in one group of enclosures, this booklet discusses the characteristics of control centers that make for flexibility of application, ease of servicing, and safety of operating personnel. Three types of control centers are described, and the various electrical components that make up typical units are illustrated and defined. A three-step building-block system of planning control centers is given, along with check charts to aid the selection of the right control center arrangement. Reference tables for proper selections of starter size are provided.

Detachable Chain

A new bulletin, 52-52, on Rex steel detachable chain has been published by Chain Belt Co., Milwaukee, Wis. Intended for use primarily by agricultural implement designers, the book will prove interesting and useful to all who buy or maintain steel detachable chain or design other type applications using this chain. The new bulletin explains the step by step manufacture of Rex steel detachable chain. Plain chain and attachments are illustrated and described. Tables giving dimensions, weight, prices, strengths, lengths, etc., are included. Interesting steel detachable chain drive and conveyer applications are illustrated. Of much value to designers are the sections of the book devoted to chain theory, chain travel, recommendations for drives and conveyers, sprocket theory, and sprocket design.

Metal Quality

A new booklet containing factual information about the development of strength and toughness in forgings is available from the Drop Forging Association, Cleveland, Ohio. The booklet consists of three distinct sections. In the first section the development of fiber-like flow line structure in steel is illustrated and described from the ingot stage through the billet and bar stage. In the second section the directional working of the fiber-like flow line structure inherent in the steel, as accomplished with closed impression dies is described and illustrated for a wide variety of forgings formed by different forging processes. The third section presents the economic and material advantages of forgings from the standpoint of design engineers, production executives, materials engineers and top management.

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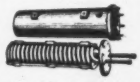

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Helical Gear Drives

Helical gear drives—their advantages, field of application, and correct selection—are discussed in a new, illustrated 16-page book No. 2451, released by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. Full-page cross-sectional views show in detail the design and construction features of both the double and triple reduction types. Installation photographs picture typical installations. All factors governing correct selection are described in detail. The right drive for any application can be chosen readily, because horsepower ratings for all drives in all ratios, for various input speeds, are shown in tabular form.

Silica Removal

To help explain one of the newer roles that ion exchangers are playing in industry, the Permutit Co., 330 West 42nd St., New York 36, N. Y., has prepared a 28-page bulletin, Demineralization including Silica Removal by Ion Exchange. Due to its extremely economical operating costs, as compared with distilled water, demineralization and silica removal through the medium of ion exchange resins has come into extensive use in all phases of industry. It is being used to great advantage in the following fields: power plants, biologicals, chemicals, drugs, pharmaceuticals, foods, beverages, solvents, electroplating, process liquors, textiles, glass, plastic products, nonferrous metals such as copper, lead, and others and the treatment of wastes of many types. This new bulletin, 3803, describes the chief applications, principles of operation, design features, advantages, recommendations, and specifications of Permutit's demineralizing and silica removal apparatus and synthetic resins.

Keep Informed

NEW EQUIPMENT
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Autronic Manual Controls

A new 4-page bulletin, A-705, on the Type M2C Autronic manual controls is announced by the Swartwout Co., Cleveland, Ohio. The bulletin gives details on features, operating principles, performance characteristics, etc.

Dust Control

A new 40-page product bulletin, "Industrial Dust Control and Recovery," has been issued by the Dracco Corp., Cleveland, Ohio. This bulletin presents technical information and data on the solution of industrial dust-collection problems. Descriptive information and specifications on the five types of Dracco dust-control equipment are included.

Pillow Block Bulletin

A bulletin titled "Now—All-Steel Dodge-Timken Pillow Blocks," describing the new series of Dodge-Timken pillow blocks in sizes from $2^{15}/_{16}$ to 10 in., has been published by the Dodge Mfg. Co., Mishawaka, Ind. Specifications and load ratings are included. The bulletin, A-620, is available on request from the company.

Magnet Chart

A new chart, "What Makes a Magnet?", describing the natural forces causing magnetism and how they are harnessed to create a useful tool for industry and the home, is offered by the Eriez Mfg. Co., 1945 Grove Dr., Erie, Pa. The chart is made up of diagrams and drawings with explanatory captions. The chart explains the potential magnetic forces found in a ferromagnetic atom. How these natural forces are organized by the application of an external magnetic field is then concisely presented.

Tool Sharpening

Case histories describing an increase in tool life of 90% to 1000% are given in a bulletin No. I-22, announced by Micrometrical Mfg. Co., Ann Arbor, Mich. Entitled "A Final Step in Tool Sharpening," this bulletin explains how time, tools, and material are saved when cutting tools produce a consistent finish; why cutting tools often produce a non-consistent finish; and what to do to obtain more consistent finish and more pieces per grind. It also tells why many companies take Profilometer readings as a standard part of their tool-sharpening procedure.

Control Valves

Ledeen Mfg. Co., Los Angeles, Calif, announces bulletin 1000, a complete catalog of Ledeen control valves. Embodying the rotating-disk construction, Ledeen valves are made to operate air and hydraulic cylinders and motors. The valves come in hand, foot, pilot, and solenoid-operated models. Illustrations of every valve and the valve components are included along with tables of flow cycles, dimensions and weights, and circuit diagrams. Data on accessories are also listed.

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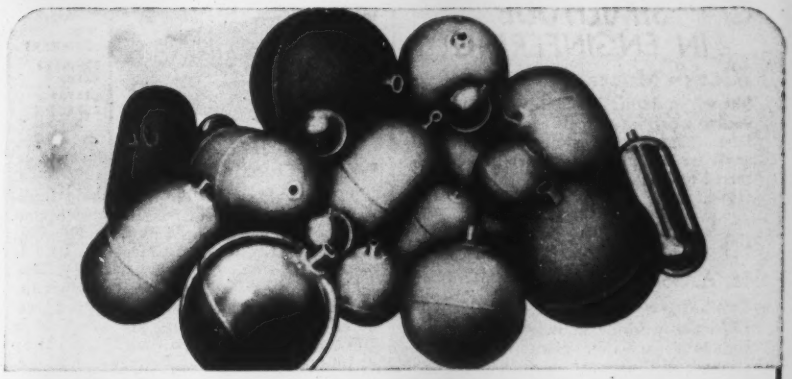

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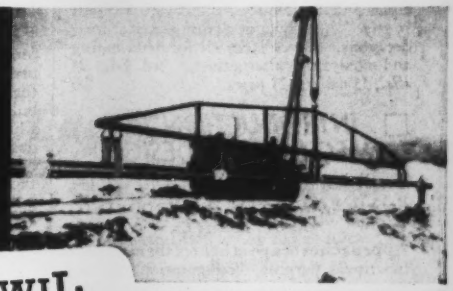

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CONTRACTOR INGENUITY—By using a suspension boom, here is how one contractor saved time by welding five 21-ft. Ric-wiL units together above-ground before lowering into trench.

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Whether you are piping steam, hot water, oil, or process liquids, Ric-wiL prefabricated units are designed for quick, economical installation. Furnished in 21-ft. lengths, pipe and insulation per job specifications are pre-assembled inside a heavy-duty conduit housing for permanent protection and high efficiency.

FORM 5205 will acquaint you with the complete range of Ric-wiL piping systems and related products. Furnished on request.

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T. B. JEFFERSON, *Editor, "The Welding Engineer"*; WALTER J. BROOKING, *M. W. Kellogg Co.*

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Friction Clutch

A new Folder No. 2437 describing Link-Belt Beyl friction clutches and clutch couplings has been anounced by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. It includes schematic drawings and dimensional tables that enable the engineer to select the right clutch or clutch coupling for each requirement. Beyl clutches are available in 10 standard sizes, ranging from 2¾ to 125 hp at 100 rpm. Positive action and easy adjustment are featured.

Diesel and Gas Engines

Construction, operation and application features of Nordberg 9-in- and 13-in. bore Diesel Duafuel and Spark-fired Gas Engines are contained in a new 12-page, three-color bulletin, 205, published by Nordberg Mfg. Co., Milwaukee 1, Wis. Pressure lubrication, high velocity cooling, efficient fuel systems, and other pertinent design characteristics of these Nordberg four-cycle engines are covered. A three-color schematic cross section of the engine points out these features and shows clearly the lubricating oil and cooling-water systems used. The construction of these engines is also discussed and the principal parts are illustrated. The engines are offered in nonsupercharged, supercharged, intercooled-supercharged and Supairthermal types to meet the operating requirements of any specific application. Typical installation pictures show these various applications.

Torque Converters

How truck-type three-stage hydraulic torque converter drives improve performance, prolong equipment life, and prevent operator fatigue in heavy hauling, is disclosed in bulletin 501, published by the Twin Disc Clutch Co., Rockford, Ill. The bulletin describes application to on-highway and off-highway units, and explains the dual advantages of highest torque multiplication for pulling and torque converter braking, both exclusive in Twin Disc converters. Two truck-type Torque Converter models are offered by Twin Disc, to make the advantages of converters adaptable to all major heavy-duty hauling jobs. Both models provide the exclusive Converter Braking feature, which forces the truck's driving wheels to drive the turbine assembly on down grades. The result is a braking effort equal to approximately two thirds the maximum horsepower rating of the engine.

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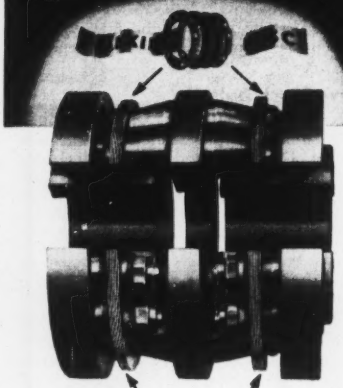
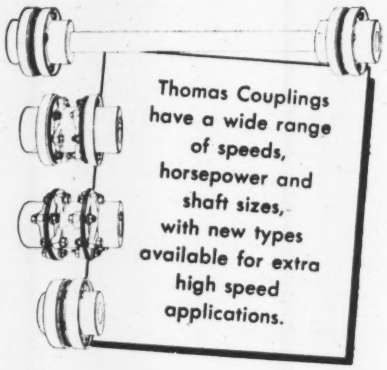


Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.



Thomas Couplings have a wide range of speeds, horsepower and shaft sizes, with new types available for extra high speed applications.

THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT
NO MAINTENANCE PROBLEMS
ALL PARTS ARE SOLIDLY BOLTED TOGETHER

Write for our new Engineering Catalog No. 51

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Air Hydraulic Pumps

Ledeen Mfg. Co., Los Angeles, Calif, announces bulletin 4000 which introduces Ledeen air-hydraulic pumps, designed for developing high-pressure oil from low-pressure air, and available in vertical and horizontal construction for maximum versatility. The bulletin discusses features of design, simplicity of operation and maintenance, effectiveness of operation, and performance. Typical and special applications of these package units are explained and illustrated with diagrams and photographs. Complete ratings and dimension tables facilitate reference and ordering.

Atmospheric Condensation

Atmospheric condensation, affecting food, steel, furniture, and other damageable items in storage, can now be avoided by an automatic control system, engineered by The Foxboro Co., Foxboro, Mass. Described in Data Sheet 000-8, the system keeps the temperature of the stored material above the dew point (moisture formation point) of the air. Since the controller takes this corrective action before moisture conditions develop, it completely eliminates a major cause of expensive storage losses.

Regulator Booklet

A new 36-page booklet, "How to Select Your Pressure Regulator, Temperature Regulator, Pump Governor," has been published by the Foster Engineering Co., Union, N. J. The booklet describes the major types of regulators, material, size, and typical installations. Tables of steam capacities, gas capacities, water capacities, and conversion factors are included.

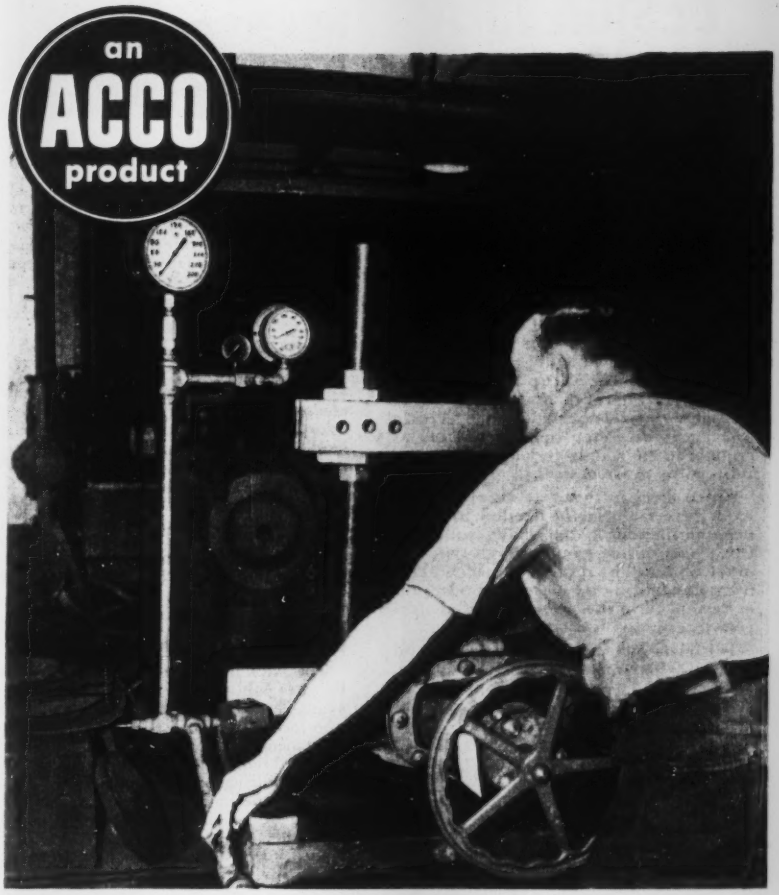
A copy is available on request on company letterhead from the Foster Engineering Co., Union, N. J.

Surface Roughness

Bulletin L21 entitled "How to Specify Surface Roughness — and Why" explains the meaning of "surface roughness" as applied to machined and finished surfaces; describes practical advantages of roughness specification; tells how to establish roughness specifications for parts in production, and for parts of new design; shows how to specify microinch roughness on working drawings; and briefly discusses shop measurement of surface roughness. Available from Micrometrical Mfg. Co., Ann Arbor, Mich.

Radial-Flow Surface Condensers

A new 32-page booklet titled "Radial-Flow Surface Condensers" is available from Westinghouse. Opening with an explanation of what the radial-flow design is, the booklet lists a number of its features. Color diagrams illustrate heat transfer, surface activity, and deaeration of condensate. Shop photographs show the type of shell construction, the way in which tube supports and tube plates are installed, tube rolling and packing, provisions for differential expansion, and shell connections. Cutaway diagrams are used to explain air baffle construction for various water-box arrangements. A two-page cutaway view with a colored overlay clearly explains steam and air flow in a two-pass condenser. Copies of the booklet, B-4350, are available from local Westinghouse representatives or Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.



Why HELICOID Gages Prove So Dependable, So Much Longer...

● Hydrostatic testing of valves on production lines gives gages a continuous workout. Every few minutes, all day long, high pressure water is run into valve after valve. Each time the gage surges up, levels off, and then suddenly drops back to zero.

Wear on gear teeth would be a constant headache—BUT not with a HELICOID Gage because—*it doesn't have teeth!* A simple stainless steel roller and long life cam absorb the surges and practically eliminate wear. Consequently, a HELICOID Gage after thousands of cycles is just as good as the day it was made.

Here you see Helicoid Gages on a hydraulic application. You can also get HELICOID Gages for pressure, vacuum, or compound service—in all pressure ranges; in various sizes and shapes; with black, white, and radiant faces; wall, stem, flush, and panel mountings, or flangeless cases.

Write today for full details on HELICOID Gages —they retain original accuracy longer, last longer, cost less per gage, per year.

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HELICOID Pressure • Vacuum GAGES

DESIGN IDEA CUTS COST ON MACHINE TOOLS

by **William B. Boice**
Boice-Crane Company, Toledo, Ohio

COSTLY machining operations like milling castings can be eliminated by designing for welded steel construction. On our jointer, for example, the top surface is now finish ground to close tolerance in one setup after welded assembly. Wherever machining is required with steel construction, precision tolerances are often held in one cut as compared to rough and finish cuts required on most castings.

Since steel is twice as rigid as gray iron, less material is needed to resist deflection under load. If made from castings, our jointer would weigh twice as much and still be subject to inaccuracies from deflection and warpage no longer experienced in the present welded steel construction.

With less material, less machining and fitting involved, shop costs are reduced. Furthermore, the modern appearance achieved with the welded design has greatly improved selling appeal.

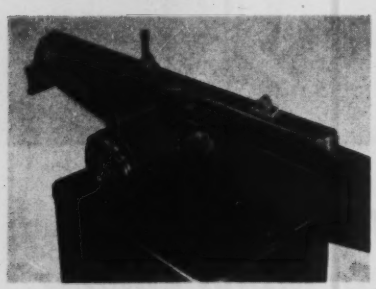

Fig. 1. Welded steel design *of 8" jointer is stronger, more rigid yet weighs half as much and costs less than cast construction. Courtesy, Boice-Crane Co.*

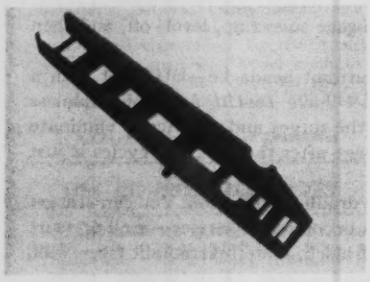

Fig. 2. Efficient girder-like structure *forms rugged frame for table. Top is welded to frame with intermittent welds, and finish ground in one setting.*

Latest simplified procedures for converting product to welded steel construction are presented in Machine Design Sheets. Available to designers and engineers by writing on your letterhead to Dept. 4801.

THE LINCOLN ELECTRIC COMPANY
Cleveland 17, Ohio

THE WORLD'S LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT

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NEW EQUIPMENT
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LATEST CATALOGS

Catalog Digest

A handily-indexed value selection booklet issued by the Ohio Injector Co., Wadsworth, Ohio, contains useful pressure-temperature rating charts and trim charts for both forged and cast steel values in addition to a pressure-temperature chart for composition disk application in bronze and iron values.

Needle Valves

Specifications and dimensions of the Lunkenheimer new gland-type needle valves are graphically described in a new, two-color illustrated circular. These precision needle valves are especially applicable to instrument lines, orifice meters, gages, by-passes, fine regulation of gases and liquids, and perform many other functions where "eye-dropper accuracy" of flow control is required. The circular shows in specific detail the wide selection of gland-type needle valves manufactured by The Lunkenheimer Co., Cincinnati, Ohio.

Ball Bearing Catalog

The Nice Ball Bearing Co., Philadelphia, Pa., has published its new Catalog No. 150, available to product designers and others who specify or purchase ball bearings for new equipment or replacement. Listings cover standard radial, thrust, and combined radial-thrust bearings of both precision and unground types, and include several new lines recently announced. Many special bearings and other Nice anti-friction products are included, together with capacity ratings, complete specifications, and engineering data.

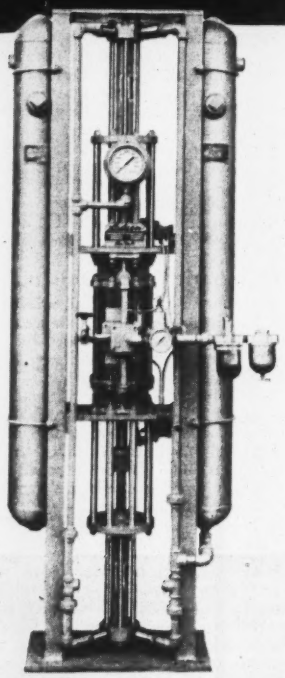
Electrode Rapping System

A new 6-page bulletin with illustrated information on the recently developed M.I. (magnetic impulse) continuous electrode rapping system for electrostatic precipitators, has been announced by Research Corp., Bound Brook, N. J., manufacturer of Cottrell electrostatic precipitators. The M.I. rapping system is a continuous, self-monitoring electrode cleaning system that improves over all precipitator efficiency and reduces operating costs. Operation of this system is explained with circuit diagrams and photographs of major conponents in the new M.I. Bulletin, which also contains a summary of exclusive M.I. rapper features.

Temperature Recorder Data

Bulletin 447, issued by the Foxboro Company, Foxboro, Mass., contains complete details of temperature recorder construction, showing how each component part, from bulb to chart, contributes to recorder accuracy. Its 20 pages provide factual information, assisting in the understanding, selection, and use of temperature measuring instruments. An entire section is devoted to selecting the correct thermal systems for temperature measurement applications. Characteristics of vapor pressure, gas pressure, and liquid expansion systems are explained in three pages of text and reference charts. Illustrations include more than 50 photographs, charts, and diagrams. Actual installations are pictured, design features checked, thermal systems charted, and complete descriptions provided for rectangular and circular case instruments, temperature bulbs, charts and accessories.

HIGH PRESSURE OIL from LOW PRESSURE AIR



Ledeen
PUMPS

Ledeen Heavy Duty Pumps and Power Units are built for operation of clamps, valve actuators, forming or drawing presses, safety installations, high pressure testing and other hydraulic circuits requiring adjustable pressure and volume and long pressure-holding cycles, without overheating the oil. Built as a complete package power unit, ready for easy installation, requiring connections only to incoming air line and outgoing hydraulic lines. Available in horizontal construction for minimum head room, and vertical construction for minimum floor space. Simple to install. Inexpensive to operate.

Write for Bulletin 4000

VALVES • CYLINDERS
AIR-HYDRAULIC PUMPS & BOOSTERS
VALVE ACTUATORS • AIR HOISTS

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Reciprocating Pumps

Installation, operation, and maintenance of Warren reciprocating pumps is now covered in a new 20 page service manual. In addition to these subjects, there is general engineering information of special interest to operating engineers. Bulletin 202, is available from Warren Steam Pump Co., Inc., Warren, Mass.

Hydraulic Conversion Table

A table of hydraulic conversion factors for pipe other than standard steel has been prepared by Stanley Lenox of The Permutit Company, New York, N. Y. The table gives factors which convert the velocity head, friction, and velocities for Schedule 40 pipe to velocities for pipes of Schedule 10 steel, rubber-lined Schedule 40 steel, Saran-lined Schedule 40 steel, Uscolite, Saran and Parian, and hard rubber.

Factors are based on the relation of velocity to cross-sectional pipe area, relation of velocity head to velocity and pipe diameter, and relation of friction loss to roughness coefficient.

Industrial Pumps

A new catalog, I-52, published by The Deming Co., Salem, Ohio, contains 96 pages of illustrated information about numerous types of industrial pumps manufactured by the company. The contents include sectional and exterior views of the various types of units, togethter with selection tables and other data of interest to pump users. Among the diversity of types of pumps featured in the catalog are standard models of centrifugal pumps including single and two ball bearing, side suction types, "Motor-Mount" types, portable types, self-priming centrifugal pumps, high pressure, vertical centrifugal pumps and split case centrifugal pumps. Also featured are sump pumps. sewage pumps, two-stage side suction centrifugal pumps, centrifugal latex pumps, vertical turbine pumps, condensation return units and hydraulic pressure test pumps.

Refrigeration Compressors

An 8-page descriptive bulletin on hermetically-sealed refrigeration compressors and condensing units of 75 to 100 hp capacity is available from the Westinghouse Electric Corporation's Sturtevant Div. This illustrated bulletin gives the inside story on the CLS compressors and condensing units: the motors, valves, pistons, crank shafts, bearings, and other smaller parts are discussed with respect to the manufacturing methods used to make them of better quality and higher serviceability. In addition, lists of available accessories for condensing units are given. A brief table of specifications gives technical data on two sizes of compressors. The standard electrical characteristics are also given. Two pages of line drawings give over-all dimensions of both compressors and condensing units. For a copy of this bulletin DB 101-160, write Westinghouse Sturtevant Div., 200 Readville St., Hyde Park, Boston 36, Mass.

For Consulting Engineers
Turn to Page 146

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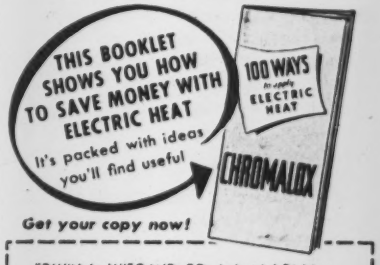
• ECONOMICAL
• EASY TO INSTALL

Regardless of your heating problems, there are Chromalox Electric Heaters that give you the heat you want when you want it. Compact Chromalox Units provide dependable, around the clock service; they are easily installed in existing or new equipment. Operating temperatures can be quickly regulated manually or thermostatically to fit the work requirements in your plant.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It's packed with ideas you'll find useful
100 WAYS to apply ELECTRIC HEAT
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Worm Gear Speed Reducers

"On-the-job" studies illustrate the money-saving results of 40 years of specialized "know-how" in the worm gear speed reducer business. Units powering equipment in such diverse industries as steel mills, pharmaceutical plants, and refineries are shown.

Booklet available from Cleveland Worm & Gear Co., Cleveland, Ohio.

Wire Thread Inserts

Suggested ways to improve products, reduce production cost, and increase customer satisfaction by using stainless-steel wire thread inserts in tapped holes fill a new 8-page booklet, 660, prepared by Heli-Coil Corp., Danbury, Conn. Text discusses design, production, marketing, and maintenance advantages offered by this method of thread protection. Photographs show a variety of products so protected in the fields of internal-combustion engines, heavy assemblies such as industrial furnaces, and the housing of impact tools. One page is devoted to a check-list, of interest to sales and production management, reciting the varied savings possible when design is based on assembly with helical thread inserts.

Portable Gasoline Hammer

"A Profitable Tool with Many Uses," is the key line of a new bulletin issued by Barco Mfg. Co., Dept. H-68, 1801 Winnemac Ave., describing applications for the company's portable gasoline powered hammers in the utility, telephone, municipal, mining, military, factory maintenance, and general construction fields. Typical applications include concrete breaking, asphalt cutting, frost breaking, ground rod driving, rock drilling, stake driving, grave digging, sheathing driving, and a variety of utility jobs. Because the Barco Hammers and Drillers are self-powered and require no compressor as an auxiliary, they can be taken easily and quickly to even remote locations for operation by a single man. New models feature an improved ignition system which facilitates easy starting and stopping. Standard hammers deliver up to 1700 strokes per min with a gasoline consumption of approximately a quart an hour. For standard and special applications, Barco offers a wide choice of tool bits and accessories, including exhaust blowers and air blowers for drilling work.

FOR TESTING Screws, thread-cutting and thread-forming screws—all types of threaded fasteners; threaded parts and threaded connections.

FOR MANUFACTURERS
DESIGNERS
INSPECTORS
TOOL ENGINEERS
LABORATORIES and for
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in assembly.

Capacities: (0-200 in. lbs.) or (0-150 ft. lbs.)

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P. A. Sturtevant Co.

2500 P.S.I.

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Available in pressure ranges varying from 30" vacuum to 2,500 p.s.i.

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"Blanking and Forming with Multipress" . . .
This 16mm sound film brings 10 minutes of fast action showing the *how* and *why* of methods applied to several production jobs . . . highlights important press features—*and shows one of the fastest hydraulic press operations you've ever seen.* Ideal for your next ASME or student group meeting, training school session, or production clinic.

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"INDEX TO PROFITS" . . . A 20-minute film showing the 13-stage assembly of an intricate 34-piece automobile door latch through a production line that cuts waste space and lost motion to the bone.

WRITE DENISON or contact the Denison representative in your area giving your film choice and preferred showing date.

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DENISON *HydrOILics*

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Closed Die Forgings

Comprehensive information on solution of design problems through use of closed die forgings is provided by a new "Problem Parts Attack Chart" published by the Drop Forging Association, Cleveland, Ohio. Major design factors listed on this chart are in order of importance as indicated by recent survey of industrial designers. Of 19 important factors, six most important, according to industrial designers interviewed, are reduced costs, improved appearance, production methods, decreased maintenance, material selection, and weight reduction, all of which have direct bearing on possibility of using forgings. Chart shows how basic qualities of forgings can contribute directly to solution of these various aspects of design problems, and suggests methods of attacking problem part problems by comparing economic and mechanical advantages of forging with other methods of production. Similar charts are being prepared to indicate ways in which closed die forgings can contribute to solving problems of process and industrial engineers, production engineers, metallurgists, and purchasing agents.

Airtubes

Lamson Corp., Syracuse, N. Y., has issued a new 50-page booklet titled, "On Target." This booklet pictures and describes many uses for Lamson Airtube systems in modern industry and commercial enterprise. It shows how the handling of paper work is greatly speeded and simplified by the installation of an Airtube system. "On Target" points out that Airtube systems serve the same purpose in management and control as assembly line conveyers do in production. With plants spreading out and paper work increasing, the advantages of a system providing fast, continuous communication are greater than ever before. Full information on carrier types and dimensions as well as basic operation of the system are included. The booklet presents a number of case histories of industrial and commercial firms which have benefited by installation of Airtube systems. A technical data section gives full details on the component parts of the Airtube system. Power units are also described to round out the presentation of all required information on Airtubes.

Insulation Specifications

Johns-Manville has issued a 52-page brochure entitled, "Johns-Manville Insulation Specifications for Oil Refineries and Chemical Process Plants." It is designed as a quick reference for engineers and others who must specify thermal insulations in these industries. The specifications are written for economy of operation, better control of process temperatures and for the safety of both personnel and equipment. The book describes the complete insulation service offered by Johns-Manville—materials, engineering, and application. Included are detailed specifications for oil refinery and chemical process plant equipment requiring thermal insulation. These specifications are divided into four main sections: (1) Insulations for temperatures above approximately 100 F, (2) insulations for temperatures below approximately 100 F, (3) tank insulations, and (4) oil-heater insulations. Seven tables of insulation thickness recommendations are included. Copies of this brochure are available by writing to Johns-Manville, 22 East 40th St., New York 16, N. Y.

"THIS LUBRICANT EXTENDED BEARING LIFE 50%"
—says REPUBLIC AVIATION CORP.
Makers of the famous F-84E THUNDERJET

"Under actual tests, LUBRIPLATE extended bearing life fifty per cent or better as compared to other lubricants. It was also found that, during test, LUBRIPLATE increased efficiency of machines twenty per cent by reducing friction loss. Republic has been using LUBRIPLATE successfully for the past eight years."

For nearest LUBRIPLATE distributor, see Classified Telephone Directory. Send for free 56-page "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

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. . . . to help fight the strongest foe in the world—*cancer.*

Who is he? *He is any generous person giving freely to the American Cancer Society's Cancer Crusade.*

He believes that the light in the "lab" must not be extinguished . . . that his fellows must learn to recognize the symptoms of cancer and the need for early diagnosis . . . that more doctors, nurses and research scientists must be trained.

A victory against cancer now may mean protection for you later. Won't you help us by giving freely—giving generously—giving now? Mail your contribution to "Cancer" care of your local post office.

Help us fight your battle
Give to the
Cancer Crusade of the

AMERICAN CANCER SOCIETY

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NEW EQUIPMENT
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LATEST CATALOGS

Centralized Lubrication Systems

The Lincoln Engineering Co., 5701 Natural Bridge Ave., St. Louis 20, Mo., has published Catalog 80, describing its lubrication application equipment for centralized lubrication systems and listing the combinations of units available to obtain various combinations of capacity and automatic and manual control and timing. Specifications of basic and accessory equipment are given, and the operating principles of the various types of systems are outlined.

Catalytic Combustion

The Catalytic Combustion Corp., 4544 Grand River Ave., Detroit 8, Mich., has published three reprints of articles on vapor, odor, and fume disposal by catalytic methods. "Fume Disposal by Catalytic Combustion," by Harold F. Borger, Plant Engineer, The Hilton-Davis Chemical Co., Cincinnati, Ohio, describes that company's experience with disposal of fumes from varnish-manufacturing kettles with Catalytic Combustion equipment, and is reprinted from *Industrial Heating*. "Paint Company Beats Odor and Fume Problem with Special Measures," by Martin E. Schleicher, Technical Director, McDougall-Butler Co., Buffalo, N.Y., reprinted from *Air Repair*, discusses McDougall-Butler's problems and experiences in processing varnishes, resins, and oils in a plant located near a residential district, using Catalytic Combustion equipment. The third reprint, "Catalytic Combustion of Hydrocarbon Vapors," is by R. J. Ruff, president of Catalytic Combustion Corp., and appeared originally in *Industrial Heating* and was presented to the U.S. Technical Conference on Air Pollution. The paper discusses the principles of catalytic combustion and the fields in which they may be applied.

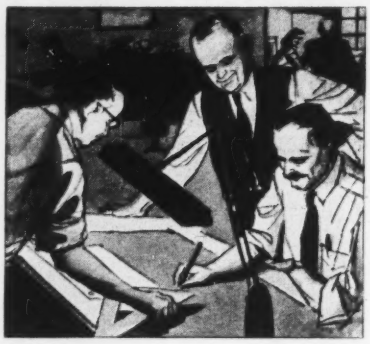
Deaerating Heaters

A detailed and informative report on the application of deaerating heaters in the feedwater cycles of boiler plants has recently been prepared by Vincent J. Calise, manager of the Research and Development Dept. of Graver Water Conditioning Co., and Robert K. Stenard, design engineer of the company.

The report discusses many different methods of adapting deaerating heaters to a wide range of conditions in both industrial power plants and central power generating stations. Included in the report are the actual experiences in determining the most suitable size, type, and design of heater for six industrial plants and four utilities, with heater requirements ranging from 50,000 to 1,000,000 lb per hr. Flow charts of installations, diagrams of selected designs, and tabulations of results are included in the explanations of the various plants.

Also included in the report are a general explanation of the various types of deaerating heaters, such as tray, spray, and combination spray-tray, with a table summarizing the characteristics of each type and comments as to the plant conditions and requirements for which each type is best adapted.

Copies of the report can be obtained by addressing Graver Water Conditioning Co., Dept. 21, 216 W. 14th St., New York 11, N. Y., and asking for the report entitled, "Experiences with Application of Deaerating Heaters in Feedwater Cycles."



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Atmosphere. A company which is growing rapidly, steadily and soundly. The challenge of production is ever present.

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MINNEAPOLIS **Honeywell**

First in Controls

Vacuum in Steam Traps

An illustrated 4-page brochure entitled "Vacuum Isn't Vacuum to a Steam Trap" discusses the following in relation to steam traps: What is Vacuum? How Does it Affect Trap Operation? Does Flash Steam from Trap Destroy Vacuum? What are Common Causes of Lack of Vacuum? Text illustrated with diagrams, charts, and examples. Copies obtainable from Armstrong Machine Works, Three Rivers, Mich.

Information Kit

A "one-a-month" information kit describing permanent magnet application ideas for industry has been announced by the Carboloy Dept. of General Electric Co., Detroit, Mich. The basic "kit" consists of a heavy permanent binder with six application ideas, each described on a separate loose-leaf page. Each month, the Department plans to issue a new magnet application sheet which will be distributed automatically to those who request the basic information kit. The first six ideas presented are: use of magnets on conveyers to transport ferrous parts, sheet steel separators, floor sweepers to pick up ferrous objects, plant layouts, tool racks, and shear tables for cutting sheet metal. Each idea sheet contains complete technical information and diagrams regarding the particular application described.

Grinding Machines

Information announcing the Brown & Sharpe new universal grinding machines No. 1, 2, 3, and 4 is included in a new booklet released by Brown & Sharpe Mfg. Co., Providence, R. I. Without omitting a single feature of the flexibility of the old design machines, increased flexibility has been added in conformity with the requirements of today. Included are specifications featuring the new important design features of these machines.

Purifiers

To help engineers, production executives, and maintenance personnel who are becoming increasingly conscious of using purifiers to clean up moisture, mist, dirt particles, guck, and other entrainment in pipe lines and equipment, the V. D. Anderson Co. has published a new 8-page folder entitled, "End Dirt and Moisture Problems the Hi-eF Way." It describes the many uses of purifiers (mechanical separators) throughout the petroleum, chemical, food, and other industries as well as in all steam-generation and distribution systems. The bulletin describes in detail how purifiers pay for themselves on live steam, exhaust steam, compressed air, vapor and gas lines. Bulletin 700, is available from the Purifier Division, the V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

Fully Crowned Tooth Design

The seven major engineering advantages of fully crowned teeth in gear-type flexible couplings, are described in a new bulletin, 1052, issued by the American Flexible Coupling Co., Erie, Pa. Applications of Amerigear Couplings for the solution of power transmission problems such as excessive offset or angular misalignment, space limitations high speeds, and torque loads, or problems consisting of any combination of these factors, are described and illustrated.

Flame-Plating

A 12-page booklet Form 8065 describing the features of a new service — the application of undiluted coatings of powdered metals, such as tungsten carbide, to metal parts — has been announced by Linde Air Products Co., a Division of Union Carbide and Carbon Corp., New York, N. Y. Properties of the coatings are covered, as well as the results of extensive comparative wear tests that indicate the excellent wearing characteristics of Flame-Plated tungsten carbide coatings. Applications that have been tested to date are included. These, together with the present limitations of the method, indicate countless possibilities for advantageous uses of flame-plated coatings wherever frictional or abrasive wear is a problem. Preparation and finishing of flame-plated parts are also described.

—for
"INSTRUMENT-QUALITY"
AIR
IN COMPRESSED AIR OPERATIONS...

HERE'S YOUR ANSWER!

HANKISON
MODEL B-30-D
Condensifilter

Featuring the New-Economical
DISPOSABLE FILTER CARTRIDGE

Dehydrate and filter ordinary plant air with a Hankison Model B-30-D Condensifilter for air of "Instrument-Quality." Condenser section removes moisture by lowering dew point of air to within 2 or 3 degrees of cooling water; low cost, disposable filter cartridge with 540 sq. in. of surface area removes even finest dirt particles. Capacity: 30 scfm at 100 psig.

Write for Bulletin B-30-D
For larger capacities, write for data on Model A-100.

HANKISON CORPORATION
353 Biltmore Building 951 Banksville Road
PITTSBURGH 16, PA.

● At Western Piping Supply, the men who weld, align, heat treat and test all have special qualifications for their particular tasks. Most, also, have many years of service with the company.

This combination of skill and experience spells out uniform quality in every job, from job to job, year in, year out. It's a good reason why WPS enjoys an exceptionally high customer repeat rate, and good reason, too, why you should specify WPS when you want superior quality piping.

WESTERN PIPING SUPPLY DIVISION
THE LUMMUS COMPANY
504 WEST 145TH STREET, EAST CHICAGO, INDIANA
Representatives in Major Cities
FABRICATORS OF CARBON AND ALLOY PIPING

Tachometers

A 20-page bulletin, S1402, describing its full line of recording and indicating electric tachometers is available from the Bristol Co., Waterbury, Conn. The instruments described include models for measuring speed of rotation or travel, processing time, speed ratios, sum or difference of speeds, and average of speeds. Featured in the bulletin are the recently announced electronic dynamaster recording tachometers. Engineering information and complete specifications on magnetos and the various types of magneto drives are given.

Close-Coupled Pump

Construction features of Allis-Chalmers supporting-adapter type, close-coupled general-purpose pump in capacities to 2500 gpm at heads to 550 ft are described and shown in the bulletin. Compact and requiring a minimum of space, the pump is available in a choice of packing or mechanical seal, and in a choice of materials. It is easy to install, requires only four bolts plus electrical and pipe connections. No special foundation is needed. Alternate sealing arrangements available are diagrammed in the bulletin and a table of dimensions is given. Copies of "Allis-Chalmers Close-Coupled Pumps," 52B6083A, are available on request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

Saran-Lined Venturi Nozzle

Builders-Providence, Inc., of Providence, R. I., has issued a new bulletin, 130-J6 on the saran-lined venturi nozzle. The Model NZSL is a flanged-type differential producer without piezometer rings, designed for corrosive liquids and slurry service. This bulletin gives pertinent information of the uses of the saran-lined nozzle and shows a sectional view of the Model NZSL. A list of corrosive liquids that can be metered with the saran-lined nozzle, a ratio chart, and capacity table for obtaining capacities for liquids other than water, is given.

Optical Gaging

A new 12-page booklet published by the Eastman Kodak Co., describes advanced methods of optical gaging to cut inspection and toolroom costs. The booklet illustrates the uses of special fixtures and charts to inspect to close tolerances large parts, complex shapes, and blind holes and recesses using contour projection. Profusely illustrated, it shows how optical gaging may be adapted to a wide variety of parts for faster, more economical checking. Specifications and features of both the Kodak Contour Projector, Model 2A, and the Kodak Contour Projector, Model 3, are described and illustrated. The booklet is obtainable from the Industrial Optical Div., Eastman Kodak Co., 343 State St., Rochester 4, N. Y.

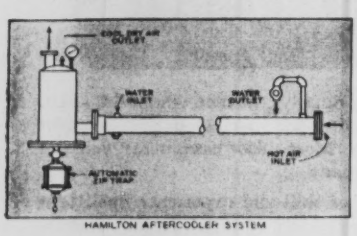
Air and Gas Proportioning

A 12-page Catalog, 805A, of interest to users of gas-fired industrial furnaces, ovens, kilns, driers, etc., has been issued by Hauck Mfg. Co., Bklyn., N. Y. It describes the simultaneous controlling and accurate proportioning of air and gas with a single control valve for manual or automatic operation. A consistent air-gas ratio is maintained over the entire range of the mixer capacity. The self-locking feature of the mixer control adjustment eliminates changing of mixture caused by hand locking adjustments. Mixer capacity tables are given for 5 different kinds of gases and for 8 air pressure ratings.

Heater Panel Ovens

Jensen Specialities, Inc., Advance Heating Division, has published the second edition of its catalog, "Jensen Pan-L-Heat Ovens," describing its line of heater panels and heater panel oven assemblies. Specifications of the panels are given and the advantages of electric radiant heat are explained. Flexibility of the heater panel oven system is emphasized in the illustrated 16-page catalog, and a method for calculating the cost of the energy that would be used by a given installation is shown. Copies are available from Jensen Specialties, Inc., Advance Heating Div., 9331 Freeland Ave., Detroit 28, Mich.

If you are up in the air about what to buy
Come down to earth where the air is dry.



HAMILTON AFTERCOOLER SYSTEM

MURPHY AFTERCOOLER SYSTEM

The Hamilton Aftercooler System is of the counter current flow design, for the greatest efficiency in cooling compressed air to within a few degrees of the cooling water; the cooled air then enters the regular patented Type A Murphy Automatic Separator where moisture is ejected through the automatic Zip Trap and cool dry air is delivered to the distributing lines.

Write for literature—send us your layout for free engineering assistance with special problems.

COMPRESSED AIR PRODUCTS

AFTERCOOLERS • SEPARATORS • STRAINERS • TRAPS
SPRAY GUNS • PISTOL SPRAYERS

JAS. A. MURPHY & CO.
460 VINE STREET, HAMILTON, OHIO
Moisture Elimination Up To 3000 Pounds Per Square Inch

EVERY STEP A SAFE STEP WITH **BLAW-KNOX GRATING**

Everyone walks safely, confidently on Blaw-Knox Electroforged Steel Grating . . . the one-piece panels stay rigid and strong—without shimmy or shake—because there are no parts to work loose. Twisted cross bars provide sure footing under the most adverse conditions. For complete information, write for Bulletin 2365.

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Industry's first choice for
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Important savings at Eureka-Williams Corp. because

ALL drawings are reproduced on Kodagraph Autopositive Paper

Positive photographic intermediates are produced *directly*, without the negative step. A standard print-making machine is used for exposure; standard photographic solutions for processing. A fast, easy room-light operation *that saves time and money!*

In print production . . . no wear-and-tear to valuable originals. The Eureka-Williams Corp., Bloomington, Ill., protects its ever-growing investment in drafting time and dollars by using low-cost Kodagraph Autopositive intermediates to obtain the desired number of shop prints. These intermediates, unlike the original drawings, will not smudge or lose line density with repeated printings . . . will produce highly legible prints time after time. Furthermore, their dense photographic black lines and evenly translucent base permit running the prints at uniform, practical speeds. *Which adds to the convenience—and the economy.*

In drafting . . . revisions made 7 times faster. The basic designs for Eureka-Williams oil burners, furnaces, and vacuum cleaners are being modified constantly for the production of various models. Here's just one way Autopositive is used to boil 3 days of drafting time down to 3 hours—

1. An Autopositive intermediate is made of the drawing which is to be revised.
2. The draftsman deletes the unwanted parts of this print with a razor blade.
3. From this, another Autopositive intermediate is made.
4. Then the draftsman only has to add the new design . . . and a new "file original" is ready. From it, additional Autopositives can be made for print production.

Costs are also cut by making Autopositives of office records, and other non-translucent records which are unsuitable for use as print-making masters.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

MAIL COUPON FOR FREE BOOKLET

Learn how thousands of companies are simplifying routines with Kodagraph Autopositive Paper, which you, or your local blueprinter, can process quickly, at surprisingly low cost. Write for a free copy of "New Short Cuts and Savings."

EASTMAN KODAK COMPANY,
Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your new illustrated booklet, "New Short Cuts and Savings."

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Company _____

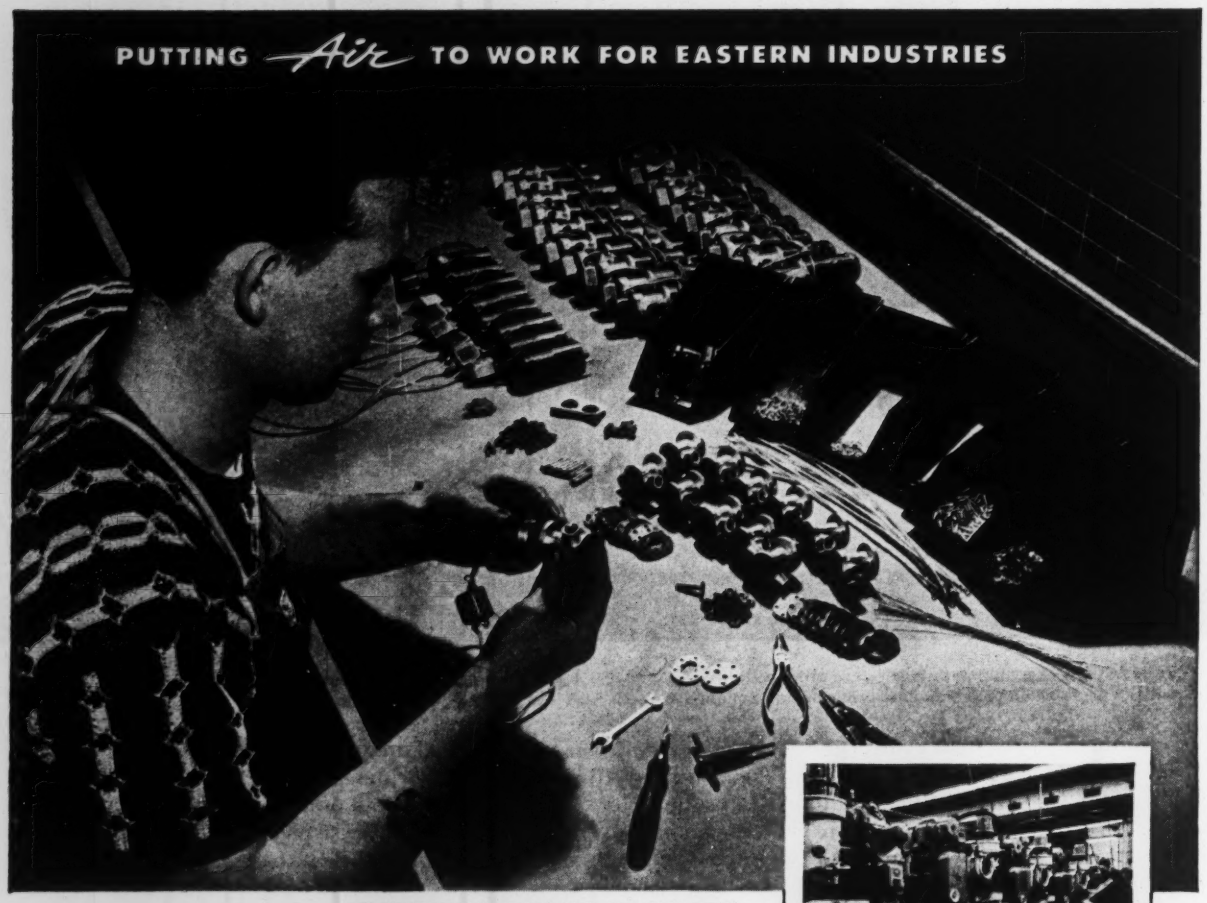
Street _____

City _____ Zone _____ State _____

16

Kodak
TRADE-MARK

PUTTING *Air* TO WORK FOR EASTERN INDUSTRIES



Machined surfaces flat to one light band—that's one-millionth of an inch —are made possible the year 'round by Westinghouse air conditioning.

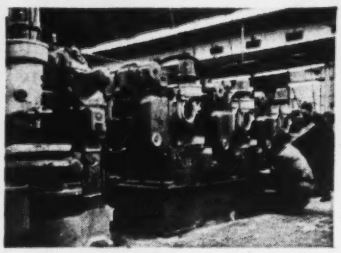
CONDITIONED AIR

HELPS WIPE A WINDSHIELD AT 30,000 FEET

This midget motor-pump sprays a grease-removing solvent onto aircraft windshields. Another provides ground-level conditions for air-borne radar in the stratosphere. Eastern Industries *mass produces* both, but with *tool-room precision.* Critical dimensions are held to plus or minus 25 millionths of an inch! That just isn't possible in hot, humid air.

The answer? Westinghouse-conditioned air maintains plant-wide, controlled atmosphere for such exacting machining, assembling, testing and inspecting. Air conditioning and air cleaning assure a constant temperature and humidity the year 'round, help guard against the dirt, rust and corrosion that will upset delicate gauges or mar super-finished surfaces.

Your product, processes and employees will do better in Westinghouse engineered air. Let us help you *put air to work* for more production, higher quality or improved methods. Check the Yellow Pages for your local Westinghouse Air Conditioning Distributor, or write Westinghouse Electric Corp., Air Conditioning Division, Hyde Park, Boston 36, Massachusetts.



Ducts supply entire building with conditioned air for precision work like this gear cutting operation.

This electronic gauge is so sensitive that even your body heat can cause deflections in its readings.

Their 100 hp Westinghouse compressor is as foolproof as your refrigerator, will give years of service.

YOU CAN BE SURE...IF IT'S

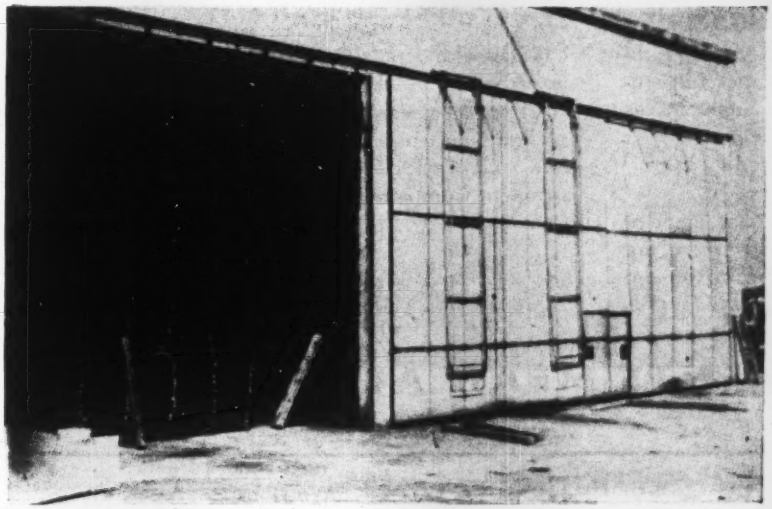
Westinghouse

AIR CONDITIONING

J-80248

"Best" New Dry Kilns Work Better with Armstrong Unit Trapping

4 Traps Increase Capacity 8%



▲ One Armstrong No. 215 inverted bucket steam trap is used on each of the four dry kiln coils at Wells-Oates Lumber Co., New Bern, N. C.

◀ The time cycle on this lumber dry kiln was reduced from 72 to 66 hours by Armstrong Unit Trapping.

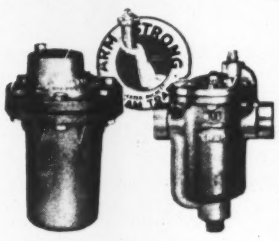
OFTEN a large capital investment in steam heated equipment is not utilized fully simply through failure to drain condensate and air efficiently. Here is a typical case:

Wells-Oates Lumber Co., New Bern, N. C., recently made one of the finest and most modern dry kiln installations possible. And it worked fine. But, it works better now, thanks to the installation of an individual Armstrong steam trap on each of the four steam coils in the kiln. The kiln cycle time has been reduced from 72 hours to 66 hours. The capacity has thereby been increased over 8% by an investment in traps of only a little over $200.

The trap installation was made upon the recommendation of DeWitt H. Skinner of Allan T. Shepherd Co., the local Armstrong Representative. The reason behind his recommendation made sense to the Wells-Oates people —*"with one trap on each of the four coils of the kiln, all coils would be properly purged of condensate and air and it would, therefore be impossible for one coil to influence the operation of another coil." The results proved the point.*

Your local Armstrong Representative may be able to show you how to get more out of your steam heated equipment. Remember, he sells a product that is *guaranted to satisfy. Call him or write:*

You always get more out of equipment when you use Armstrong "Unit Trapping"



ARMSTRONG MACHINE WORKS

894 Maple Street, • Three Rivers, Michigan

SEND FOR 44-PAGE STEAM TRAP BOOK

a Catalog and Educational Handbook on Condensate Drainage

Attach to your Company Letterhead and Mail Today.

ARMSTRONG MACHINE WORKS
894 Maple Street, Three Rivers, Michigan
Please send me a Steam Trap Book.

Name .....

Title .....

. . . Let Taylor

Perhaps we've been hiding our light under a bushel. Over a period of 20 years we have developed and perfected volumetric load measuring elements which have been utilized almost exclusively in the paper industry. They've been used, in indicating, recording and controlling form, to measure calender stack pressures, paper machine press section pressures, beater roll pressures, Jordan plug pressures, etc. There are many applications throughout industry where they can be used to measure tension on conveyor belts, thrust on bearings, forces applied by pneumatic or hydraulic cylinders, weight of solids or liquids in tanks, and force applied to testing apparatus.

The instrument comprises a measuring element, made of hardened alloy steel, connected to a Bourdon spring in an indicating, recording or controlling instrument by means of a mercury filled capillary tubing in lengths up to 200 ft. The measuring element is installed in the direct line of force, so as to be independent of friction or other factors which would affect accuracy of measurement. Most recent developments afford a wide variety of ranges, greater range suppression, greater over-range protection, and greater energy for positioning the pen or actuating a control mechanism.

While applications shown below all illustrate compression load measurement, tension loads also can be handled with a maximum load not to exceed 30,000 pounds.

There are many more logical applications for these highly accurate and sensitive instruments. *What is your problem.* Call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

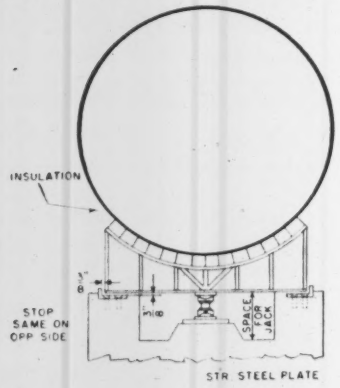
• • •

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

Problem

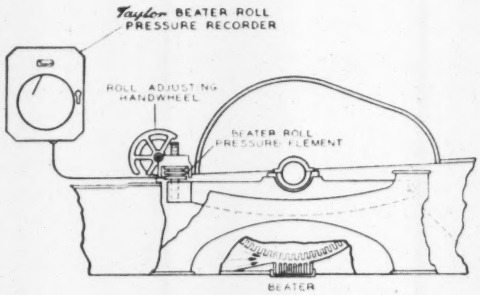
To accurately measure the weight of chlorine in tanks.



Spool type Load Measuring Element.

Solution

To accurately measure processing pressure in paper stock beater.



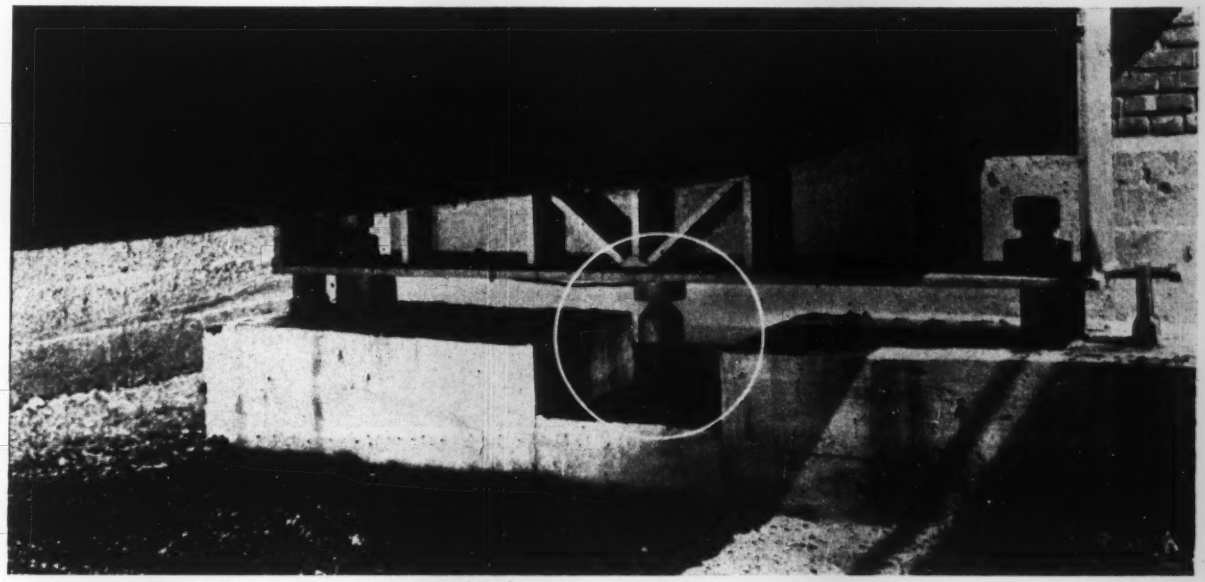
Ring type Load Measuring Element.

Characteristics

Range limits: 0-250,000 lbs. for compression loads, maximum load not to exceed 400,000 lbs. Applicable to horizontal or vertical tanks, containing corrosives or solids, making conventional level measuring devices impractical. Tension loads 0-30,000 lbs.

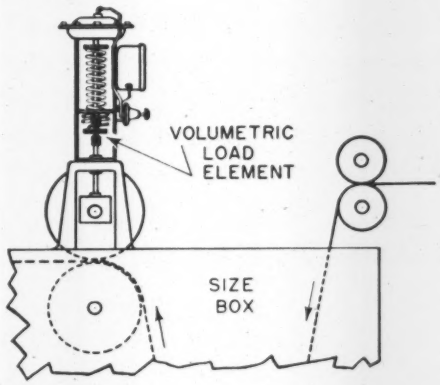
Range limits: 0-20,000 lbs., maximum load not to exceed 20,000 pounds—compression only. Similar to diaphragm type, but with hole through center of element for load-screw or shaft. Another application is the measurement and control of Jordan plug pressure.

carry your load



Spool type Volumetric Load Element indicating direct weight of chlorine in tanks (0 to 80,000 pounds) at Niagara Falls, N. Y., plant of Niagara Alkali Company

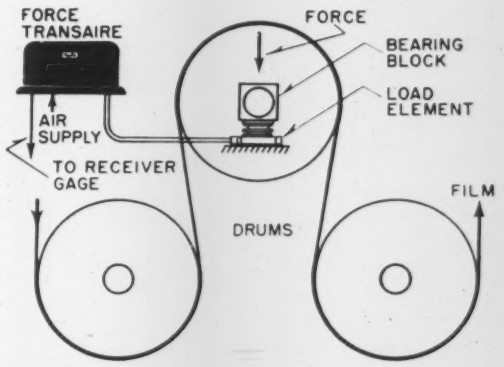
To accurately measure squeeze roll pressures on textile slashers.



Diaphragm type Load Measuring Element.

Range limits: 0-5,000 lbs. maximum load not to exceed 6250 lbs. Compound ranges, tension—0—compression also available. Applicable to measure roll or nip pressures in calender stacks, press section and many other finishing operations involving processing of material between rolls.

To measure film tension within very close limits as a measure of "gain" or percentage of stretch.

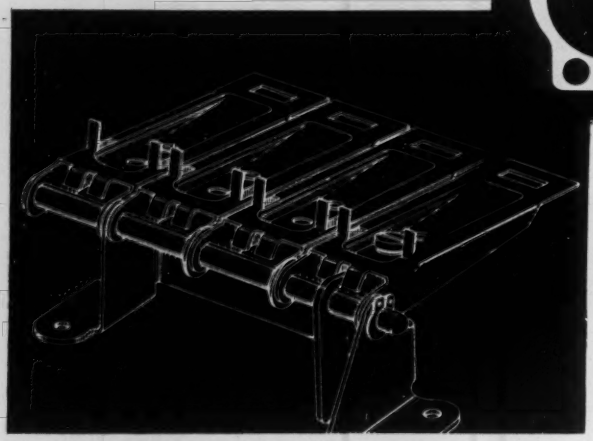


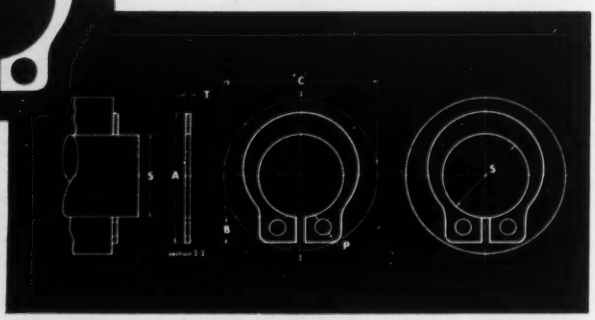
Volumetric Load Measuring Element.

Range limits: 0-300 lbs. in range spans as short as 30 lbs. Used in conjunction with a TRANSAIRE* Pressure Transmitter which gives an output pressure proportional to the force applied. Applicable to film, paper, yarn or similar tension measuring requirements.

*Reg. U. S. Pat. Off.

New Waldes Truarc GRIP Ring requires no groove, holds fast by friction, can be used over and over again





Ring # 5555		5555-12	5555-13½	5555-18	5555-25	5555-31	5555-37
SHAFT DIAMETER	Fract. Equiv. S	1/8"	—	3/16"	1/4"	5/16"	3/8"
	Dec. Equiv. S	.125	.136	.187	.250	.312	.375
	TOL.	±.002	±.002	±.002	±.002	±.003	±.003
RING DIMENSIONS	Thickness T	.025	.025	.035	.035	.042	.042
	TOL.	±.0015	±.0015	±.002	±.002	±.002	±.002
	Length A	.268	.285	.364	.437	.553	.626
	Lug B	.078	.078	.097	.097	.141	.141
	Hole P	.042	.042	.042	.042	.078	.078
	Min. Ring Clear C	.33	.34	.44	.50	.67	.73
Approx. Ultim. Thrust Load (Lbs)		20	20	25	35	50	60

The Waldes Truarc Grip Ring is a new, low cost fastener that provides a positioning shoulder secure against moderate thrusts or vibration. Installed on a straight ungrooved shaft, the Truarc Grip Ring can be assembled and disassembled in either direction with Truarc pliers.

The Grip Ring can be installed tightly against a machine part in order to take up end-play. The basic Truarc design principle assuring complete circularity around periphery of the shaft and the ring's unusually large radial width combine to exert considerable frictional hold against axial displacement. The ring can be used again and again.

Find out what Waldes Truarc Retaining Rings can do for you. Send us your drawings. Waldes Truarc engineers will give your problems individual attention without obligation.

SEND FOR NEW CATALOG ➧

WALDES

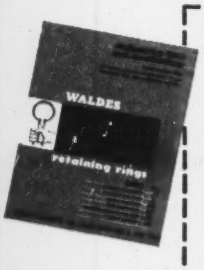
TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,952; 2,420,921; 2,420,341; 2,439,785; 2,441,846; 2,458,185; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.



Waldes Kohinoor, Inc.,
47-16 Austel Place, L.I.C. 1, N. Y. ME-035

☐ Please send me sample Grip-Rings (please specify shaft size _____)

☐ Please send me the complete Waldes Truarc catalog.

(PLEASE PRINT)

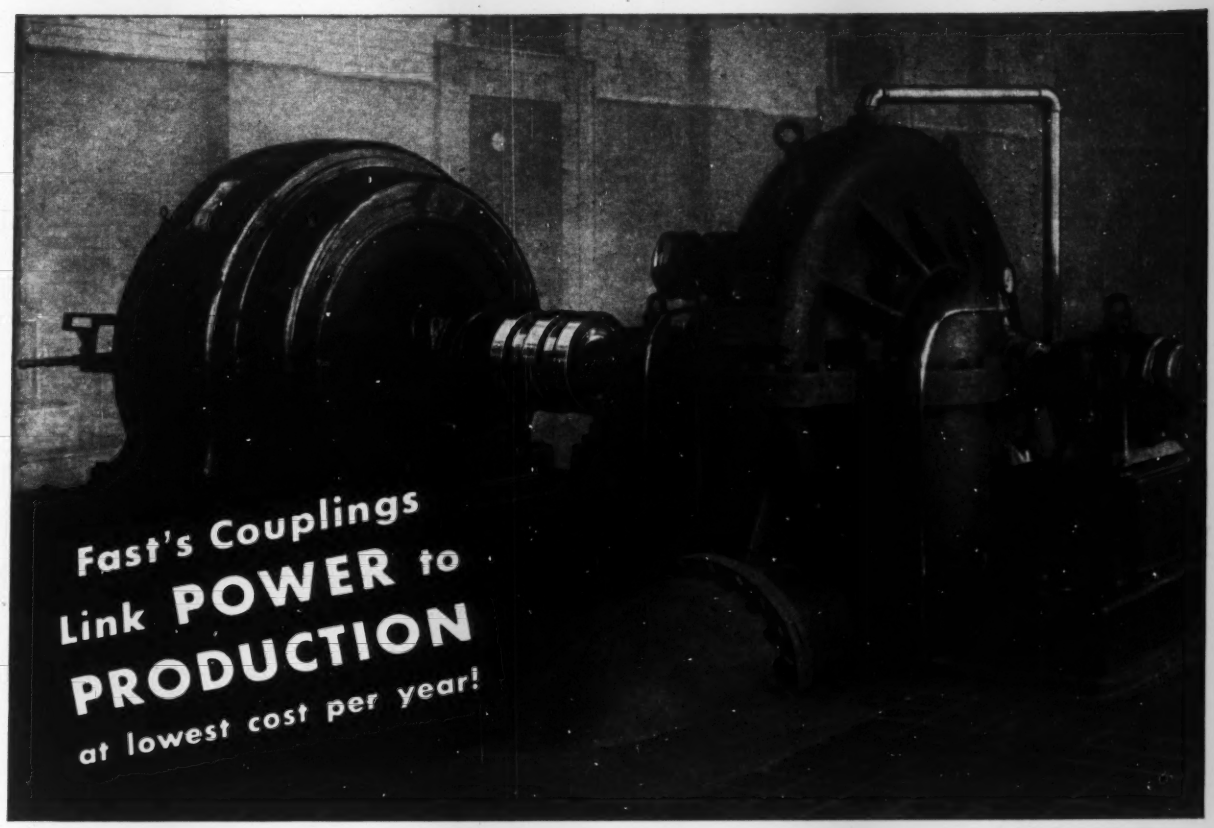
Name _____

Title _____

Company _____

Business Address _____

City _____ Zone ____ State _____



FAST'S Couplings usually outlast the equipment they connect!

ACTUAL cases on record show many Fast's Couplings are still in service after as much as 30 years of continuous operation! Time and time again, equipment has been replaced while the original Fast's Coupling remained on the job.

To you, these records of dependable, trouble-free service mean freedom from costly coupling failures when you specify Fast's. And they mean Fast's cost you far less to own and operate . . . because their cost can be amortized over long years of dependable performance.

For full details on how Fast's Couplings and Koppers Engineering Service can help you, write today for a free copy of our catalog to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 253 Scott St., Baltimore 3, Maryland.

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS

FAST'S®
THE ORIGINAL
GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

KOPPERS COMPANY, INC., *Fast's Coupling Dept.,*
253 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

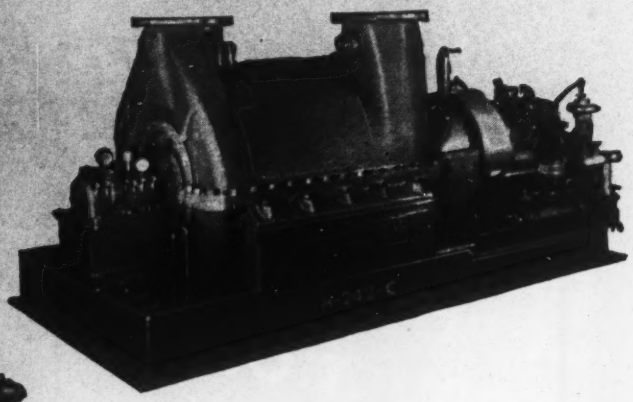
Name .....

Company .....

Address .....

City ..... *Zone* ..... *State* .....

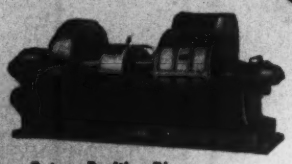
LET *Specialists* DO THE JOB OF MOVING GAS OR AIR



CENTRIFUGAL BLOWERS AND EXHAUSTERS
single and multi-stage units, in capacities from 2,000 cfm to 100,000 cfm or higher, at maximum practical pressures.

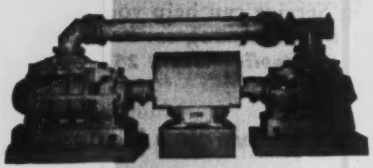
Rotary Positive Gas Pumps
5 cfm to 50,000 cfm.

Inert Gas Generators
1,000 cfh to 35,000 cfh.



Rotary Positive Blowers and Exhausters
5 cfm to 50,000 cfm.

Positive Displacement Meters
4,000 cfh to 1,000,000 cfh.



Cycloidal Vacuum Pumps
500 cfm to 13,000 cfm.

ROOTS-CONNERSVILLE

Exclusive Specialists in Handling Gas and Air

One advantage of dealing with Roots-Connersville for blowers, exhausters, meters and related equipment is that we are specialists in this field. It's been our only business for almost a century. Today, we combine this long experience with up-to-the-minute thinking, to supply the most reliable and economical machine for your specific job.

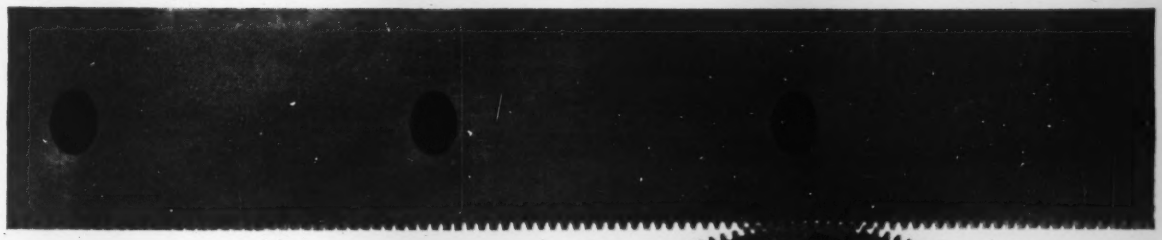
Then, there's the wide versatility of R-C equipment. Our exclusive *dual-ability* line includes Centrifugal and Rotary Positive types, in standard sizes for most work. Because we build both, our recommendations are unbiased.

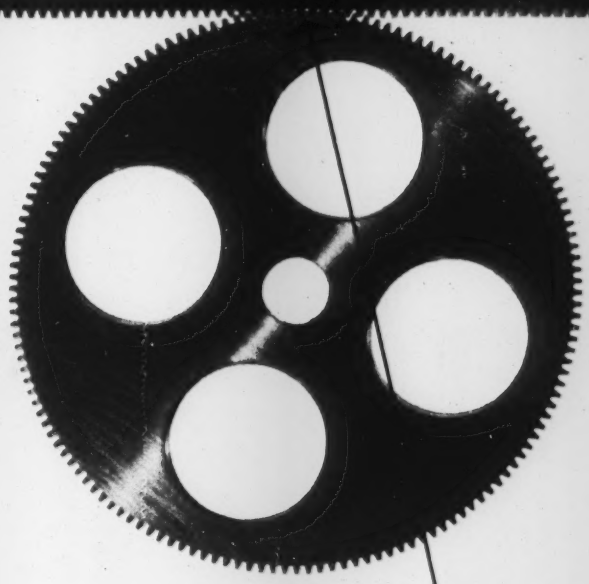
In our Rotary Positive Gas and Vacuum Pumps and Meters, and in Inert Gas Generators, there's a similar, wide choice in types and capacities, closely matched to specific needs.

We suggest that on *any* problem of handling gas or air at moderate pressure, for industrial purposes, you ask us for definite recommendations. Detailed bulletins are available on request.

BLOWER BUILDERS SINCE 1854

ROOTS-CONNERSVILLE BLOWER A DIVISION OF DRESSER INDUSTRIES, INC.
453 Michigan Ave. • Connersville, Indiana





Why you can *reduce rejection losses* with a Kodak Conju-Gage Gear Checker

Why the composite check

In practice, the final test of gear quality is how the gear works in use. The composite check recommended in American Standard B6.11-1951 shows this conclusively by measuring displacement of the gear when run against a master of known accuracy. And it does it in one quick operation that checks combinations of as many as six types of errors.

Why the Conju-Gage Gear Checker

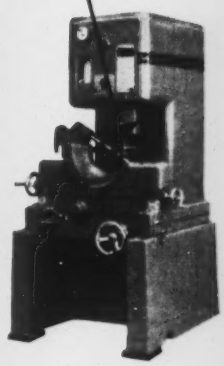
Since displacement represents the sum of both gear error and error in the master, the accuracy of the master used determines the precision of the composite check. The Kodak Conju-Gage Gear Checker uses a master of exceptional accuracy, the Conju-Gage Worm Section. Produced by thread grinding, its accuracy is not limited by the same manufacturing processes which limit accuracy in the gear itself.

To settle for masters of lesser accuracy is to rob yourself of "tenths"—to chance that tolerable error in a gear may coincide with error in the master to cause a needless rejection. Or that intolerable error in a gear may be cancelled by error in the master to pass a gear that will fail in use.

To reject every wrong gear is to guard the quality of your product. To pass every right gear is to reduce such rejection losses to a minimum.

To find out more about how a Kodak Conju-Gage Gear Checker can lower costs while maintaining required precision, send for your copy of the booklet, "Kodak Conju-Gage Gear Testing Principle." Write to

Industrial Optical Division
EASTMAN KODAK COMPANY, Rochester 4, N. Y.



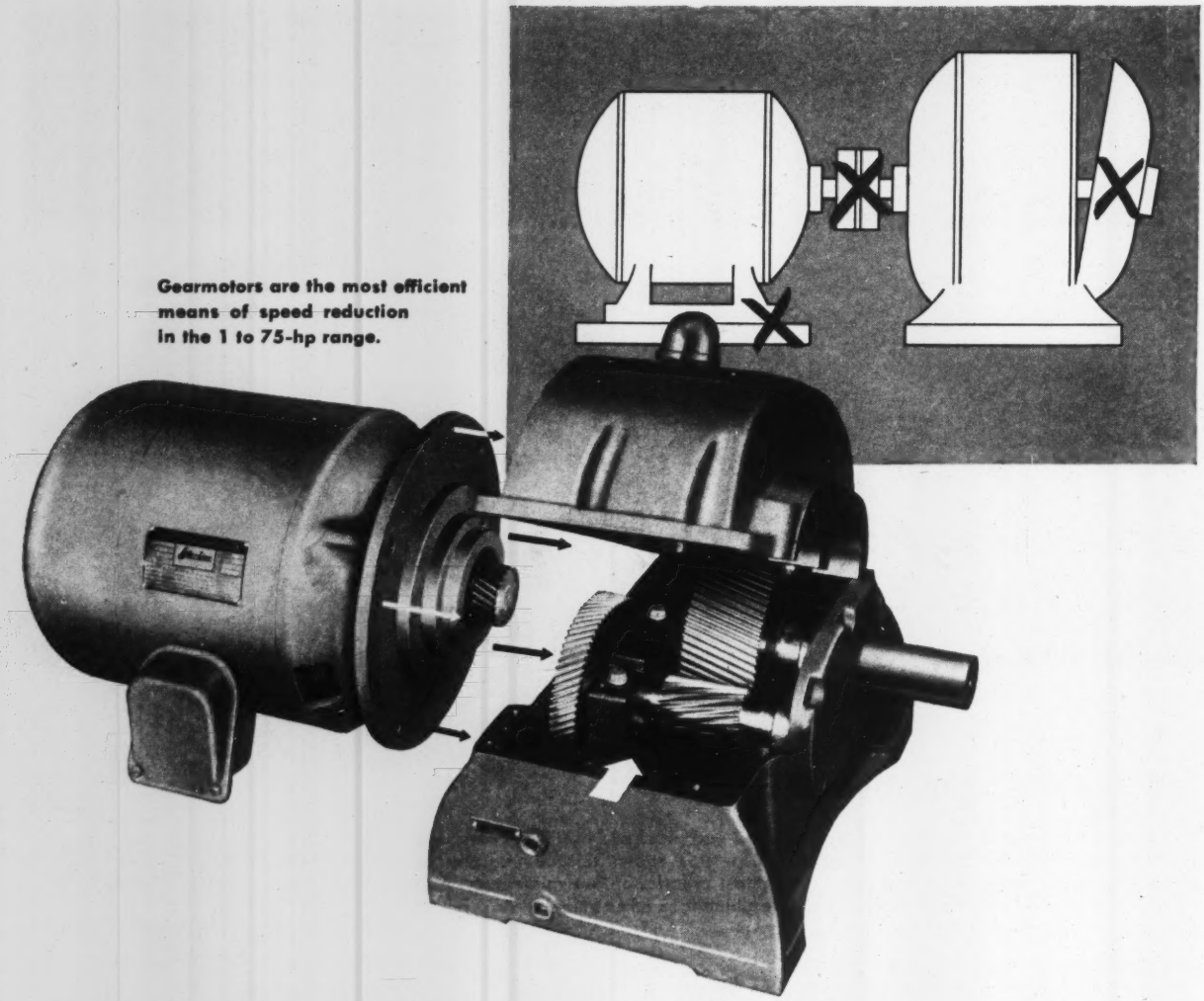
The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variations, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 8U, for gears up to 8¼" pitch diameter. Smaller models are also available.

CONJU-GAGE INSTRUMENTATION

. . . a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak



Gearmotors are the most efficient means of speed reduction in the 1 to 75-hp range.

Here's why *Life-Line* GEARMOTORS stay on the job longer

LESS TIME OUT FOR SERVICING MOTOR

Removing the motor from a Life-Line gearmotor takes but a few minutes. Remove the motor mounting bolts and you are on your way—and, reassembly is just as simple and fast. Install the mounting bolts and the job's complete. No realigning of shafts—no coupling to adjust—no mounting feet to shim.

Should you be "on the spot" where down time is critical, this means that your spare motor can be quickly and easily installed. At the most, it is a simple assembly of the adapter bracket.

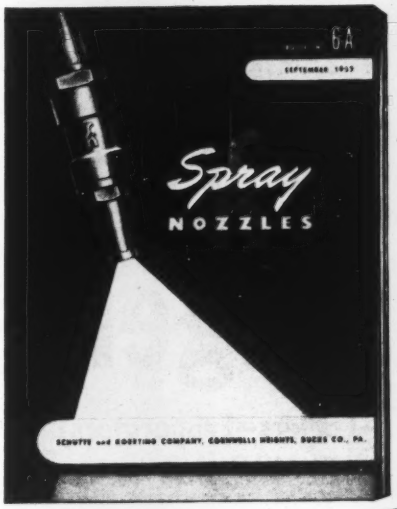
LESS TIME OUT FOR SERVICING GEARS

Here again, Life-Line's split case construction pays off. Simply by removing the top half of the gear case, the gears can be inspected or removed without touching the mounting bolts—without draining the oil—without disturbing the connected load.

Ask your Westinghouse representative for the details on how Life-Line gearmotors pay for themselves in production time saved. For descriptive literature, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-07313-A

YOU CAN BE SURE...IF IT'S Westinghouse

New SK Bulletin Simplifies Selection of Spray Nozzles



Bulletin 6-A—just issued—contains detailed, concise information on the many types of Spray Nozzles manufactured by SK. It was designed to enable industrial buyers to specify the right nozzle to meet application requirements.

A tabular index in the front of the catalog lists each nozzle by number and gives its primary application, spray characteristic, materials of construction and the page showing detailed description.

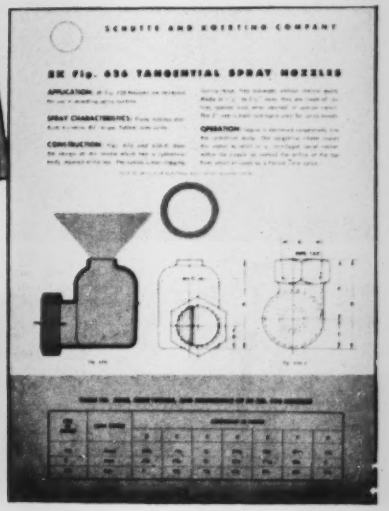
For ready reference, Atomizing Nozzles, Spray Nozzles and Spray Nozzle Clusters are treated in separate sections.

Construction, spray characteristics and capacities are given for each type of nozzle, and differences in design or materials of construction are noted. Descriptive material and illustrations are supplemented by dimension tables and capacity charts.

SK Spray Nozzles are widely applied in mixing, coating, cooling and scrubbing processes. Other typical applications range from atomizing, washing, and aerating liquids to absorbing gases.

Bulletin 6-A is made up of 20 pages of complete, useful material. Request a copy for your files. It's yours for the asking.

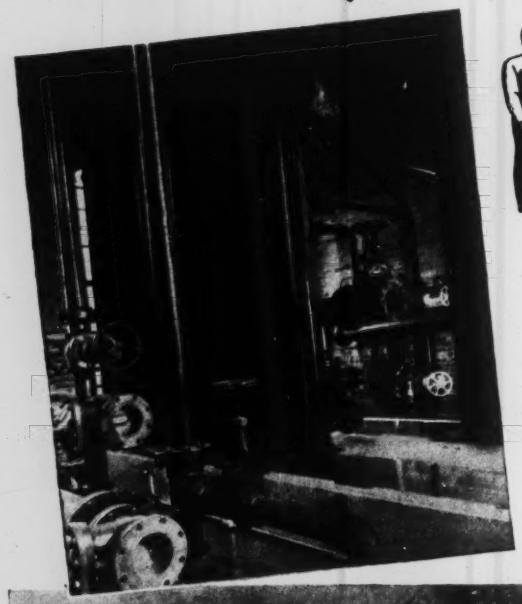
SCHUTTE AND KOERTING COMPANY
Section 2
SK SPRAY NOZZLES HOLLOW CONE AND SOLID CONE TYPES
SCHUTTE AND KOERTING COMPANY
SK Fig. 632 SPRAY NOZZLES



Manufacturing Engineers

Dirty Water can't "Shut-down"...

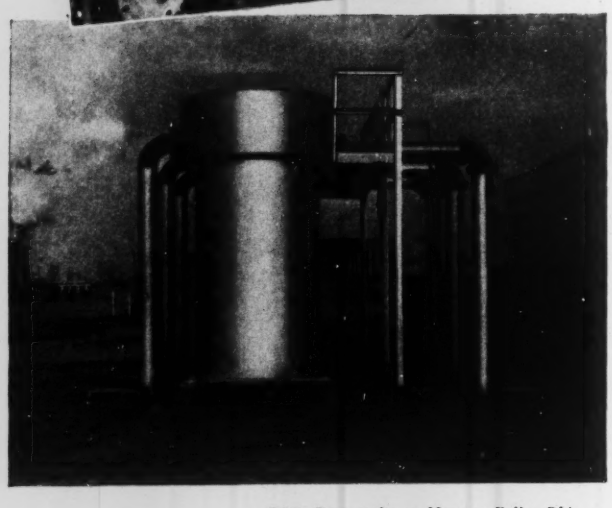
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

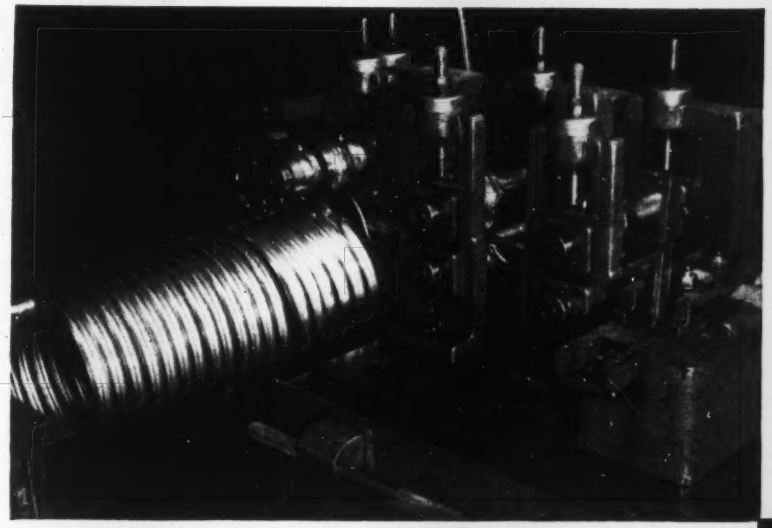
TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

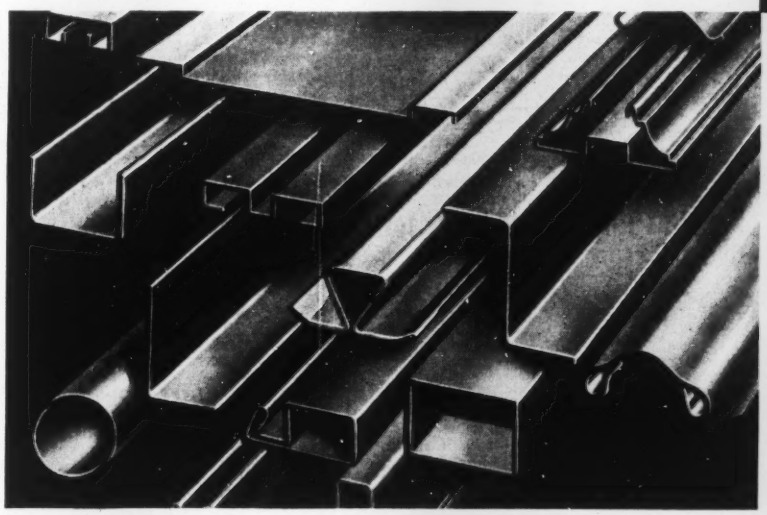
HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.



Curving Coiling and Ring Making

IN A COLD ROLL FORMING MACHINE



CURVING and coiling to almost any diameter, are two out of many operations which can be performed in a Yoder roll forming machine. As fast as formed, the sections can be continuously coiled and cut to length to make rings for auto hub caps, headlights, wheel trim, stator rings, etc., at a huge saving in cost of materials and labor.

Among other operations which can be tied in with cold roll forming may be mentioned embossing, notching, perforating, welding, flattening, lock-seaming, filling and closing tubular shapes, wrapping, edge trimming, etc.

In the design and assembly of production lines of this character, the know-how of the Yoder engineering staff is at your service. The Yoder book on Cold Roll Forming deals broadly with the most important phases of the subject. Ask for it.

•

THE YODER COMPANY
5499 Walworth Avenue
Cleveland 2, Ohio

Complete Production Lines

- ★ **COLD-ROLL-FORMING and auxiliary machinery**
- ★ **GANG SLITTING LINES for Coils and Sheets**
- ★ **PIPE and TUBE MILLS–cold forming and welding**

ENGINEERING YODER MANUFACTURING

Facts prove the economy of RUST-OLEUM®

Apply Directly Over Sound Rusted Surfaces

Just scrape and wirebrush to remove rust scale and loose particles — then brush Rust-Oleum 769 Damp-Proof Red Primer *directly over sound rusted surface.*

Lasts Longer Applied Directly Over Rust

Sandblasting, chemical pre-cleaning and other costly preparation methods are *not* usually required. Rust-Oleum penetrates the rust to bare metal, incorporating the rust particles into the coating.

Many Colors, Including Aluminum, and White

Rust-Oleum finish coatings incorporate the same basic rust-inhibiting vehicle as Rust-Oleum 769 Damp-Proof Red Primer. They provide *double protection* and enable you to *beautify as you protect.*

Practical Answer to Your Rust-Producing Conditions

Rust-Oleum resists rain, snow, heat, fumes, sun, salt water, and chemicals. So easy to use by brush, dip, or spray that one man often does the work of *two.*

Proved Throughout Industry for Over 25 Years

Indoors and out, Rust-Oleum has *proved* its capacity to stop rust! Rust-Oleum can do the same for your tanks, metal sash, stacks, girders, roofs, buildings, machinery, pipes, etc.

An Exclusive Formula

Rust-Oleum is *distinctive* as your fingerprint. It incorporates a specially-processed fish oil vehicle that *dries,* is *odor-free,* and is formulated in *many colors.* Specify Rust-Oleum — accept no substitutes.

There Is Only One Rust-Oleum

RUST-OLEUM STOPS RUST!

ATTACH TO YOUR LETTERHEAD — MAIL TODAY!

RUST-OLEUM CORPORATION
2902 Oakton Street, Evanston, Illinois

- ☐ Have a Qualified Representative Call
- ☐ Free Survey
- ☐ Complete Literature
- ☐ Nearest Rust-Oleum Industrial Distributor

Sunbury Plant of Pennsylvania Power & Light Co., Sunbury, Pa.

Pennsylvania Power & Light Company's

SUNBURY STATION

world's largest anthracite-fired steam electric plant, is "supported" by

GRINNELL HANGERS

Pennsylvania Power & Light Company at its Sunbury Plant faced the problem of providing flexible, but constant support, to main steam piping carrying superheated steam under a pressure of 1350 pounds per square inch, and at a temperature of 950°F.

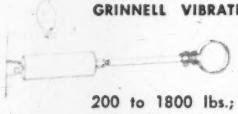
For "support" on that tough assignment . . . Pennsylvania Power & Light turned to Grinnell. And that is understandable. Grinnell is America's No. 1 supplier of pipe hangers and supports. Grinnell combines modern manufacturing with expert background knowledge gained during a century of piping specialization. Grinnell, and Grinnell alone, can offer these advantages:

- Complete "start to finish" production facilities — including research, design manufacturing, engineering and field service.
- Practical experience in every type of piping gained during the past 100 years.
- Coast to coast distribution — enabling "out of stock" purchases, anywhere.

Call on Grinnell . . . "whenever piping is involved."

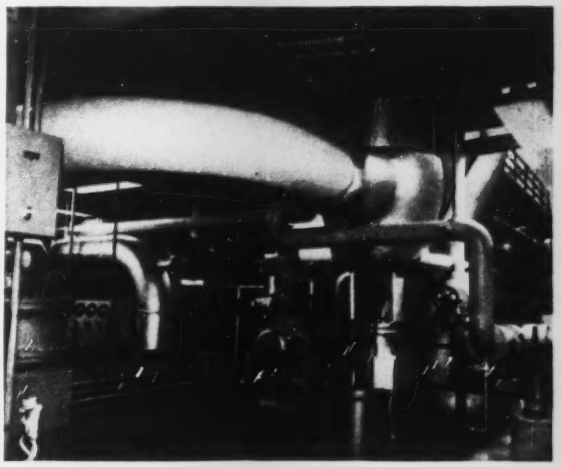
GRINNELL MODEL L CONSTANT-SUPPORTS maintain full safety factor in high temperature, high pressure systems. 3 physical structures accommodate maximum travel requirements of 2½, 5 and 10 inches; 16 sizes collectively cover numerous load ranges between 141 and 19,530 pounds.

GRINNELL PRE-ENGINEERED SPRING HANGERS — maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. 16 sizes available from stock — load range from 74 pounds to 9000 pounds.



GRINNELL VIBRATION CONTROL AND SWAY BRACES—dampen vibration, oppose pipe sway and absorb shock. 3 sizes give full deflection forces from 200 to 1800 lbs.; have initial precompressed spring forces from 50 to 450 lbs. respectively.

Twin Grinnell Constant Support Hangers provide uniform lift for steam turbine throttle valve to prevent stresses in piping as it moves from "cold" to "hot" positions.



GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPLIES

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

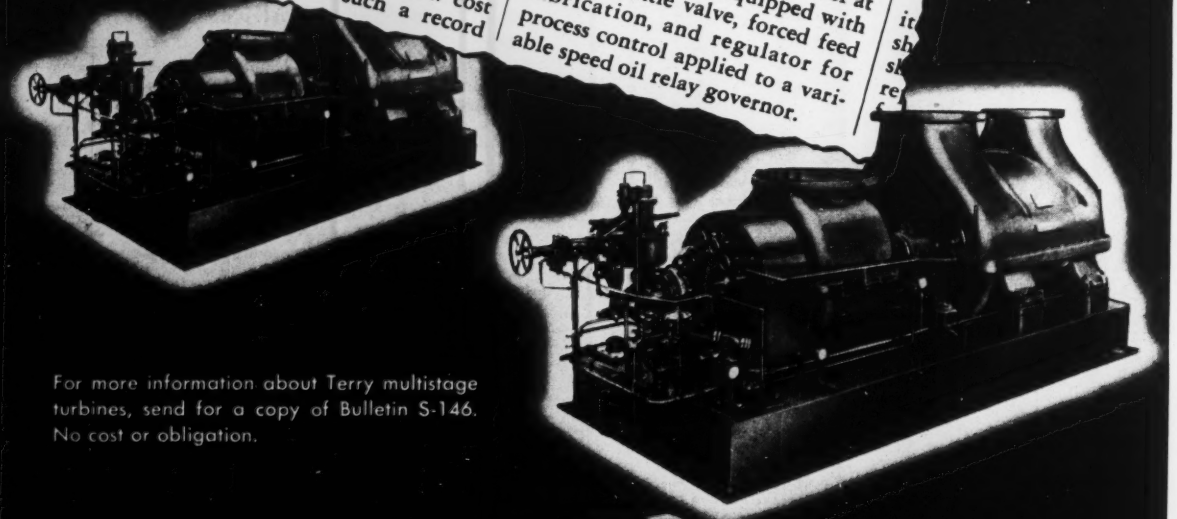
After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, they ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.

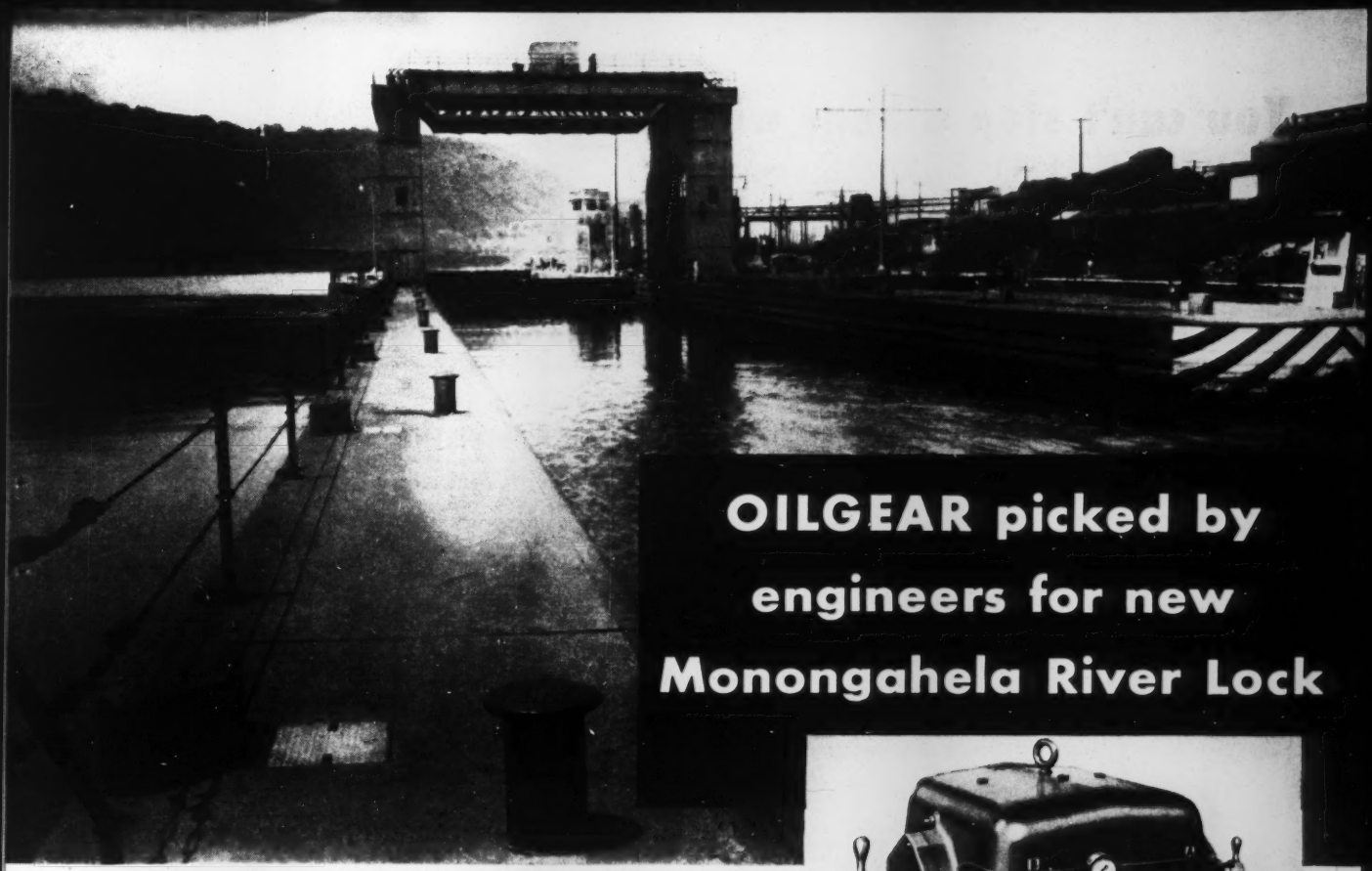


For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

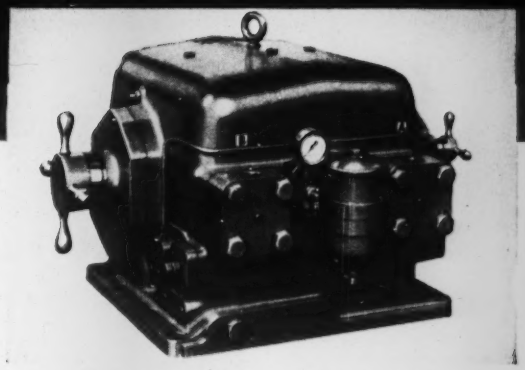
THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT 1193



OILGEAR picked by engineers for new Monongahela River Lock

Photo courtesy Corps of Engineers, US Army



Oilgear Two-way Variable Delivery Pump with Electro-hydraulic Three-position Remote Control.

This versatile fluid power also used in McNary Dam and Bayou Boeuf Locks

The problem of selecting the power to operate the lock gates, butterfly valves and capstans in the new Monongahela River Lock was to provide the speed of operation, the capacity and the dependability that would keep the rapidly growing volume of shipping on the move. The river at this point now handles millions of tons more annually than Panama.

Certainly, in the fact that Oilgear Fluid Power equipment was selected for this lock, as well as for those at McNary Dam in Oregon, and at Bayou Boeuf in Louisiana, is evidence of the repute in which Oilgear is held.

But we are inclined to stress the *versatility* of Oilgear Fluid Power . . . its applicability to a wide range of needs ranging from the impressive capacity required for lock operation . . . to the delicate and assured precision, controllability and accuracy required in printing on flimsy cellophane . . . and to the middle ground of industry where production must always be increased and always kept on the move.

Fundamentally there is no difference. There must be power, *ample* power, susceptible of control some times rushing and gigantic, some times a mere whisper of power whittled down to a point, as it were.

With Oilgear Fluid Power available in pump and cylinder for straight line motion, or in pump and motor or integrated transmission for rotary motion or reduction of ratio, you have a power source and method applicable to any need. In addition, you gain ability to vary speed or power steplessly in an extremely broad ratio. You can have power that does not move but simply holds a member under constant pressure. You can have speed that clings closely to the changing viscosity of a beaten mass... or power that forms giant airplane fuselages and wings.

Whatever your problem, it deserves the opportunity to be matched with Oilgear versatility for a better solution. It will cost you nothing to investigate. It may show you a tremendous gain. THE OILGEAR COMPANY, 1570 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

You can't stop a bear with a fly swatter

You can't stop corrosion with ordinary paints... it takes BITUMASTIC COATINGS!

CORROSION can't be stopped by ordinary paints or conventional protective coatings. They can't protect surfaces against the ravages of rust for any appreciable length of time. But Bitumastic Coatings can!

BECAUSE the six Bitumastic® Protective Coatings, unlike maintenance paints, are specially formulated from a coal-tar pitch base* that is, for all practical purposes, impervious to water. When you keep moisture away from an exposed surface, you *stop* corrosion.

BECAUSE Bitumastic Coatings provide an extra-tough, extra-thick barrier against corrosive elements—a barrier that is impenetrable. These coatings provide up to 8 times the film thickness of conventional paint coatings.

BECAUSE Bitumastic Coatings stop corrosion caused by moisture—acid fumes—alkaline fumes—salt air—heat.

There are 6 Koppers Coatings—formulated to control corrosion of metal and deterioration of concrete. Use the coupon for full information, or see our catalog in Sweet's Plant Engineering File.

**Hi-Heat Gray contains a metallic base.*

SEND FOR SET OF FREE BOOKLETS!

Koppers Company, Inc., Tar Products Division
Dept. 371-T, Pittsburgh 19, Pa.

Please send me, without charge or obligation, complete information on corrosion prevention.

Name.....

Address.....

City..... Zone..... State.....

KOPPERS **BITUMASTIC PROTECTIVE COATINGS** SOLD THROUGH INDUSTRIAL DISTRIBUTORS

KOPPERS COMPANY, INC., Tar Products Division, Dept. 371-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

New! *Look what Powers has done to* ***Modernize*** *Control Valves*

Powers NO-PAK Valves Banish Packing Maintenance
Prevent leakage of water or steam or loss of vacuum

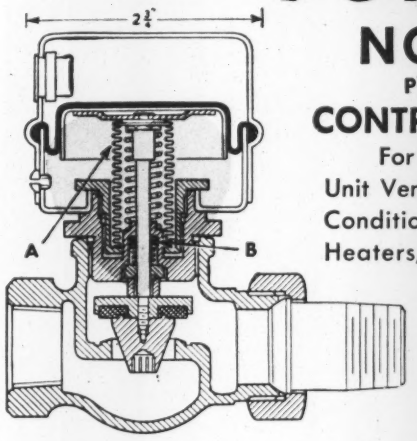
POWERS

NO-PAK

Pneumatic

CONTROL VALVES

For Convectors, Unit Ventilators, Unit Air Conditioners, Baseboard Heaters, Radiators, etc.



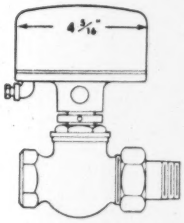
Various Types and Sizes for all requirements

Another POWERS Contribution to Better Heating and Air Conditioning Control

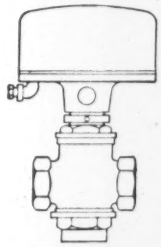
NO-PAK valves with their many advantages are now standard with Powers temperature control systems. Their superior performance is due to Duo-Seal construction.

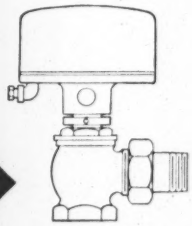
Bronze Packless Bellows (A) in sectional view above, is the primary seal which eliminates packing maintenance — packing friction — steam and water leakage or loss of vacuum. It is designed to withstand pressure up to 150 psi. Maximum valve stroke is only two-thirds of the normal bellows stroke. A spring loaded secondary seal (B) permits servicing of valve top without draining the water system or shutting down the steam heating system. Seal is made of highly elastic neoprene and is ready to act at any time. Small contact between seal and the highly polished stainless steel stem makes friction a negligible factor.

For utmost dependability and lowest cost maintenance specify control by Powers NO-PAK Valves.

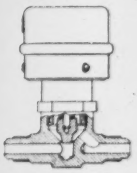


Straightway Union
3-Way Screwed Ends

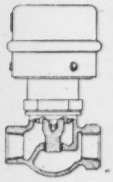


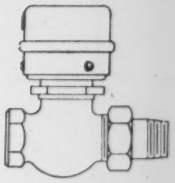


Angle Union

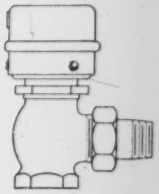


Flared Ends



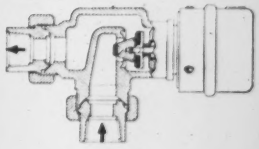


Straightway Union



Angle Union
Screwed Ends

Below: Reverse Flow Double Union



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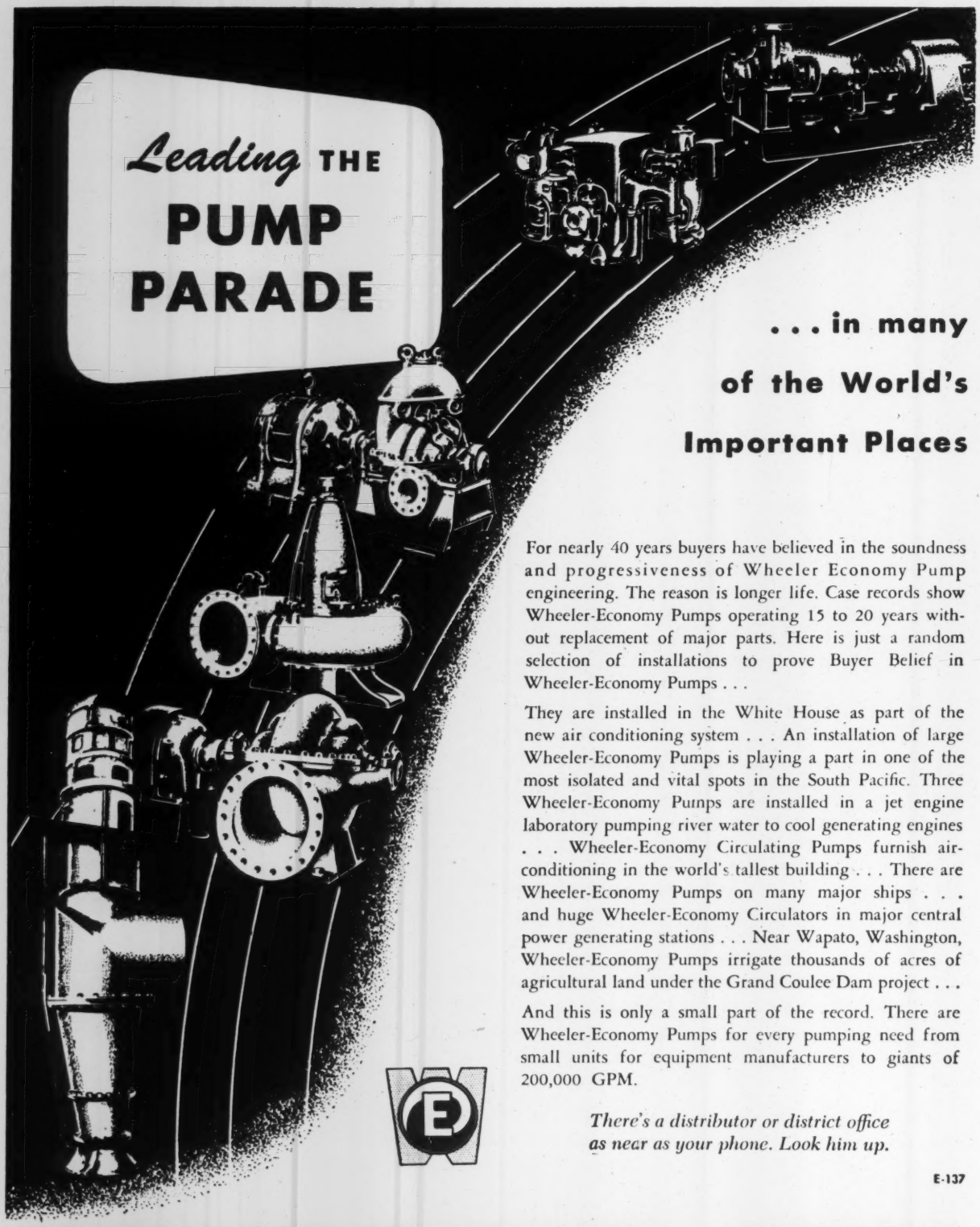

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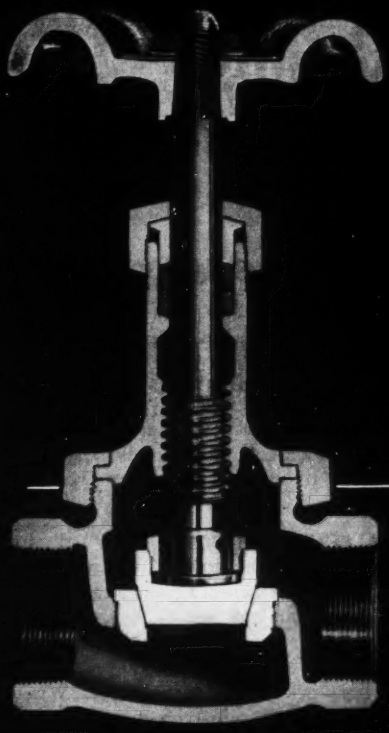

BRONZE

COMPLETE LINES OF BRONZE VALVES AND PIPE FITTINGS are manufactured by Walworth in a variety of types, pressure ratings, sizes, and patterns, including Walseal® Bronze Valves and Fittings for making Silbraz® joints.

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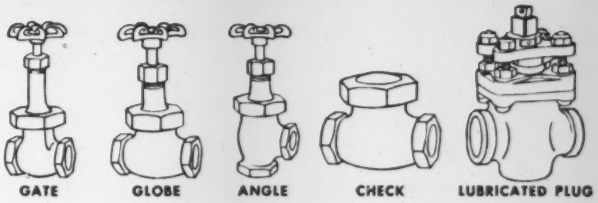
Walworth engineers will be glad to help you with your problems. For full information call your local Walworth distributor, nearest Walworth sales office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



Bronze valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 225P Bronze Globe Valve. This valve has a working steam pressure rating of 350 psi at 550F (1,000 psi non-shock cold water, oil, and gas pressure). It features a renewable, plug type, stainless steel seat and disc, heat treated to 500 Brinell hardness.

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DESIGN OR APPLICATION—light and heavy structural supports for machinery... high pressure piping and systems... rotating machinery ... steam turbines, general steam apparatus and steam power systems... heat exchangers and condensers... hydraulic apparatus and systems, fluid flow, systems evaluations, heat balance, valve design ... mechanical and hydraulic devices and mechanisms (thorough knowledge of properties of materials required).

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REMEMBER! We are primarily interested in good *experienced* application and development engineers—lack of previous reactor development experience *is no handicap in this type of work.*

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In other words, right now we're more interested in your ability to fill current openings and to develop in the Westinghouse Atomic Power Division than we are in your vital statistics. Write your letter of application accordingly.

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MONEY? Good jobs are open here now—waiting for good men who want to make a permanent connection.

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SUBURBAN LIVING? It's here—within easy driving distance of your work. Within a few minutes of shopping centers... schools... metropolitan centers.

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Users of Piping

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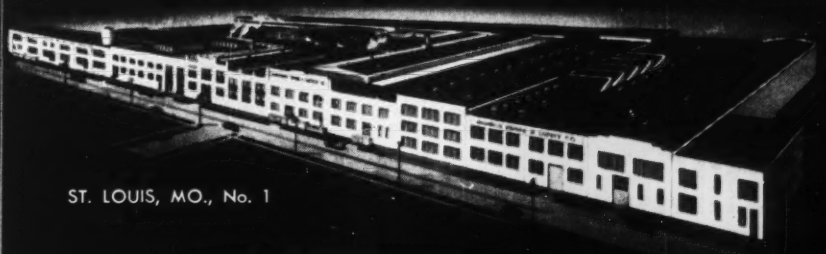
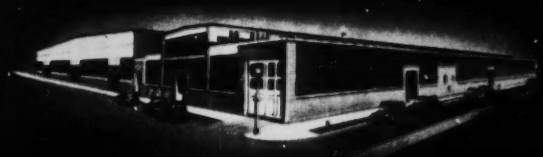
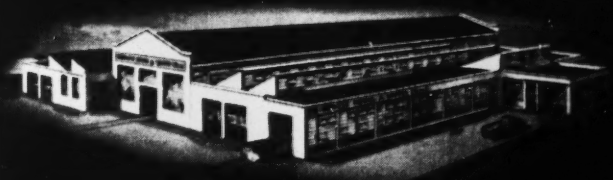


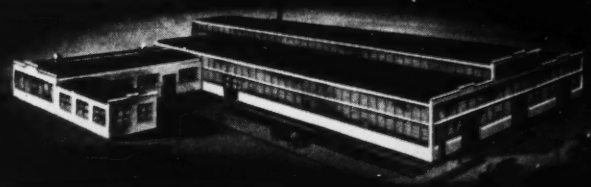
ST. LOUIS, MO., No. 1

ST. LOUIS, MO., No. 2

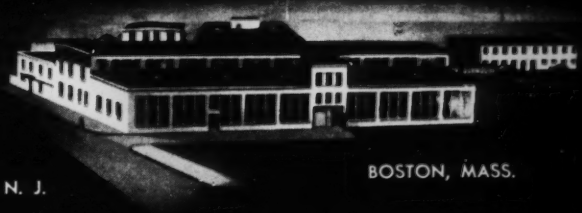




LOS ANGELES, CALIF.



PASSAIC, N. J.



BOSTON, MASS.

Strategically located multiple plants and large scale operations have made it economically practicable for Midwest to develop much special pipe fabricating machinery and to conduct piping research that would be impossible under other circumstances. Multiple plants create a friendly rivalry between the organizations of these plants that advances the art of piping fabrication more rapidly than would otherwise occur. All these activities are reflected in better fabricated piping . . . in greater piping value per dollar. • Multiple plants help make Midwest the preferred source for prefabricated piping. 4909

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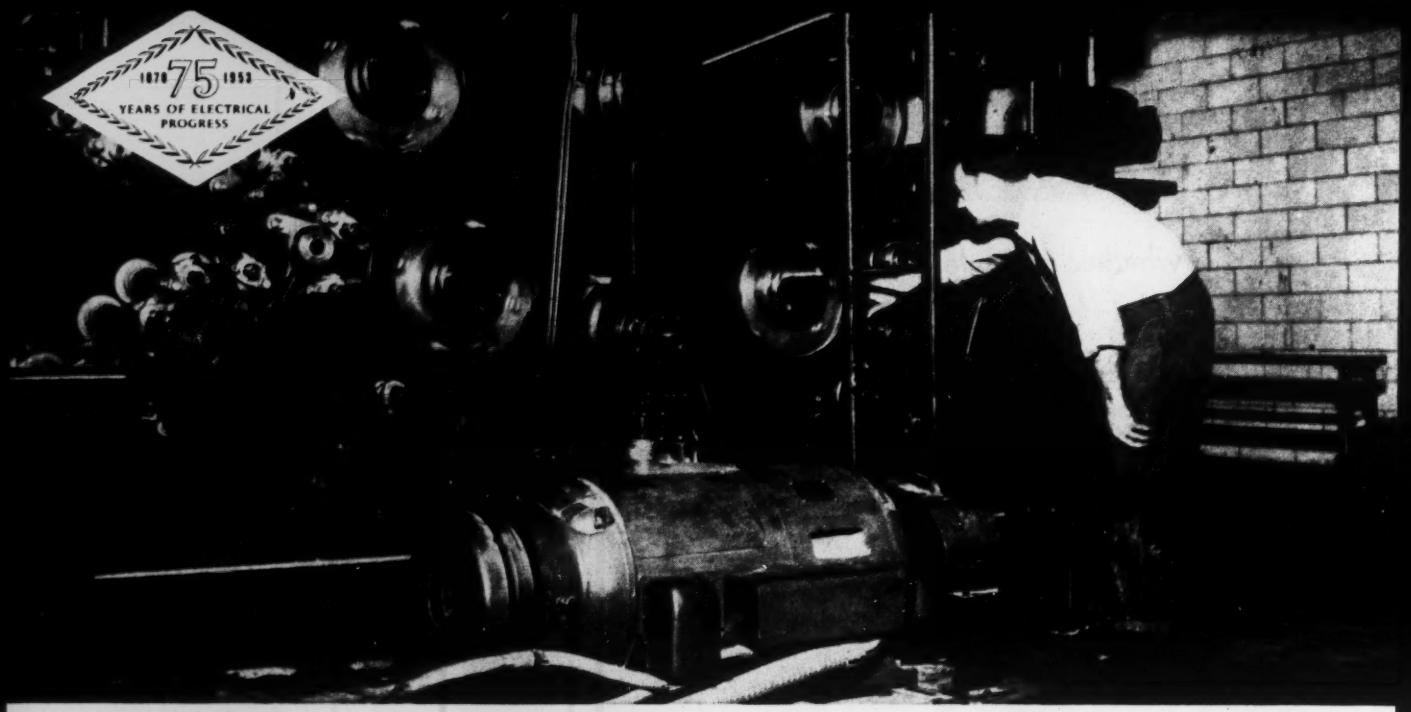
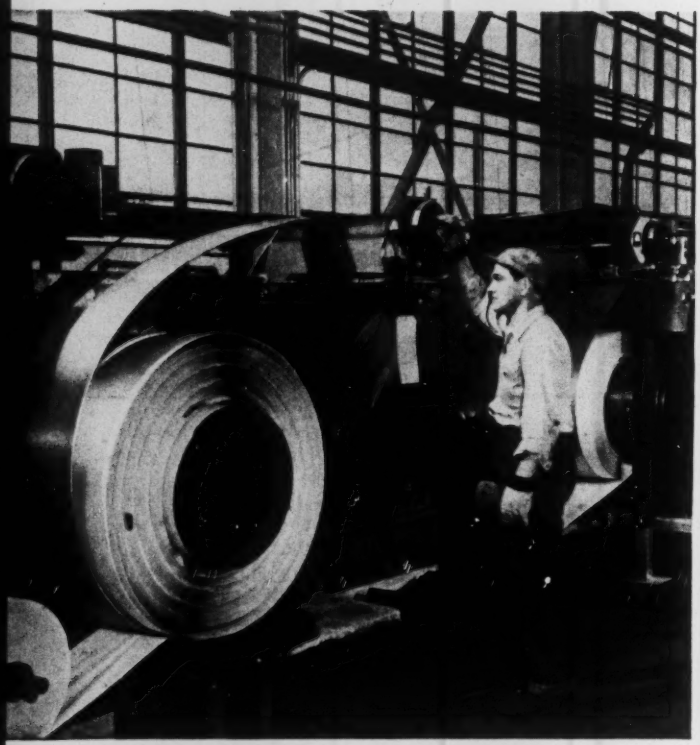
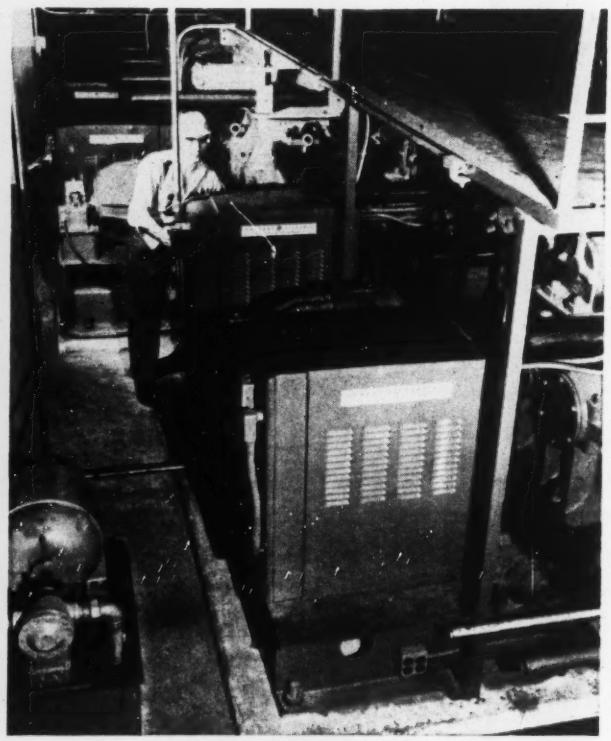
PIPING FABRICATORS AND CONTRACTORS FOR MORE THAN 50 YEARS



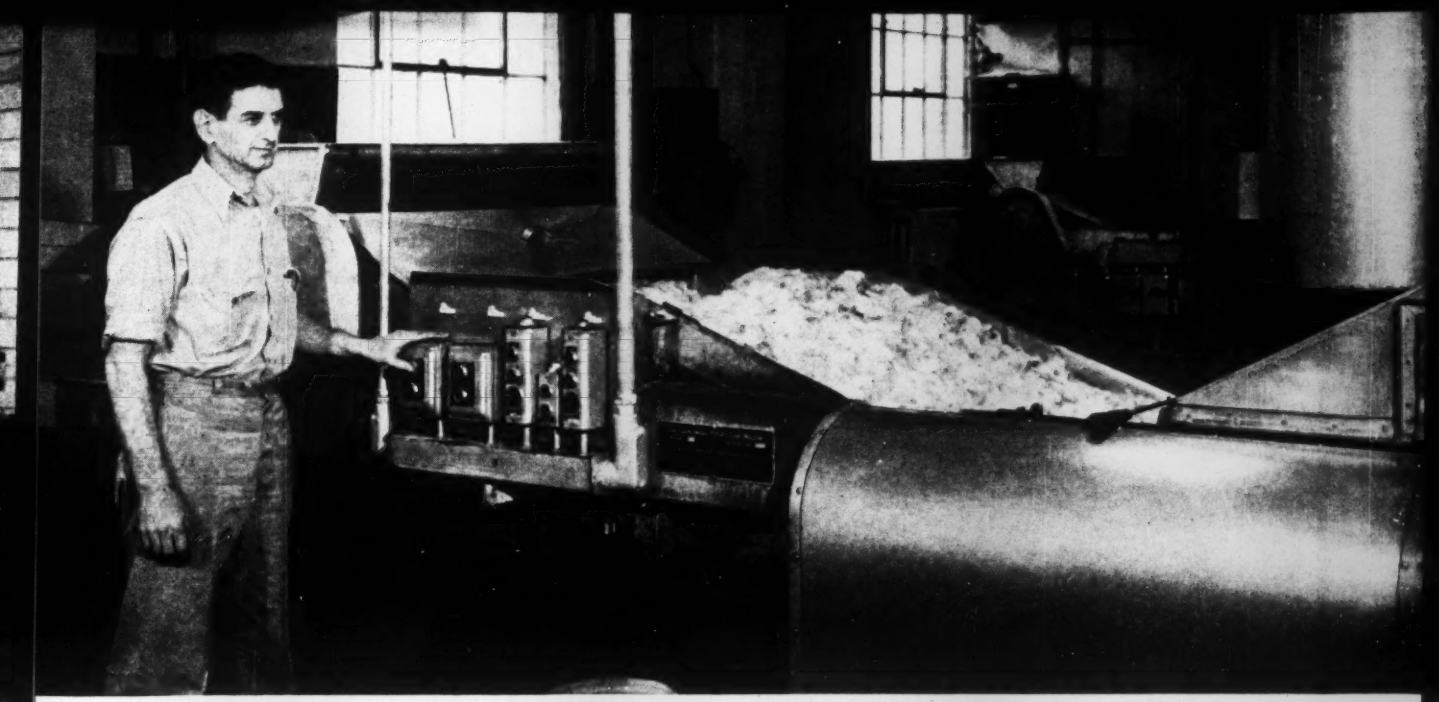
G-E ACA MOTOR is the main drive on this five-color press at Alford Cartons, manufacturers of folding boxes, Ridgefield Park, New Jersey. Working from AC current with no conversion equipment required, the ACA Motor is the low cost way to Adjustable-speed Drive performance. You get stepless speed adjustment within a speed range of from 3 to 1, 6 to 1, and 20 to 1.

Make your machinery more versatile





G-E SPEED VARIATOR boosts winders "spooling" chrome strip steel at Wallingford Steel Co., Wallingford, Conn.—handles all speeds from 5 to 80 feet per minute. G-E Speed Variators, with speed ranges up to 40 to 1, are complete "package" units—available in ratings from 1 to 200 hp. For even greater accuracy and versatility, these drives may include amplidyne or electronic regulators.



G-E THY-MO-TROL* DRIVE at the El-Ge Potato Chip Co., York, Pa., electronically regulates potato chip processing where accurate speed control is extremely important to the finished product. Thy-mo-trol drive is available between 1/40 and 75 hp, offers smooth speed adjustment ranging up to 100 to 1 and can be made to hold regulation as close as ±½% regardless of changes in voltage.

with a G-E Adjustable-speed Drive!

G-E ADJUSTABLE-SPEED DRIVES offer you the chance to get the most from your machinery investment. You can step up production, minimize material waste, improve product quality, and enjoy the ability to produce a greater variety of goods.

THERE IS A G-E ADJUSTABLE-SPEED DRIVE FOR YOU. Whether you need speed regulation within ±½% or ±10% you can get an economical Adjustable-speed Drive from the full G-E line. From the G-E ACA motor which requires but a simple twist of a dial . . . to the G-E Thy-mo-trol drive which permits precise electronically controlled drive speeds . . . General Electric manufactures a drive that will enable you to produce better and more uniform products. Packaged drives are available in sizes from 1/40 to 200 hp. Depending on hp, speed ranges are available from 3 to 1 up to 100 to 1.

FOR FULL INFORMATION consult your nearest General Electric Apparatus Sales Office. Your G-E Sales Representative will be glad to recommend the most economical drive best suited to your operation. For printed information on the complete line of Adjustable-speed Drives, use the coupon.

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You can put your confidence in—

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LET G.E. HELP YOU PICK THE RIGHT DRIVE

Because only General Electric makes all major types of electric adjustable-speed drives, it is best qualified to help you select the right drive. Send for these informative bulletins.

☐ A. This 26-page manual describes all four types of drives and where to apply them. Bulletin GEA-5334.

☐ B. Lower cost, simplest a-c drive. Bulletin GEA-4883.

☐ C. More flexibility, moderate cost. Bulletin GEA-5335.

☐ D. Top performance, 1/70—75 hp. Bulletin GEA-5337.

☐ E. Top performance, 1–200 hp. Bulletin GEA-5336.

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Please send me the bulletins checked
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☐ for planning an immediate project

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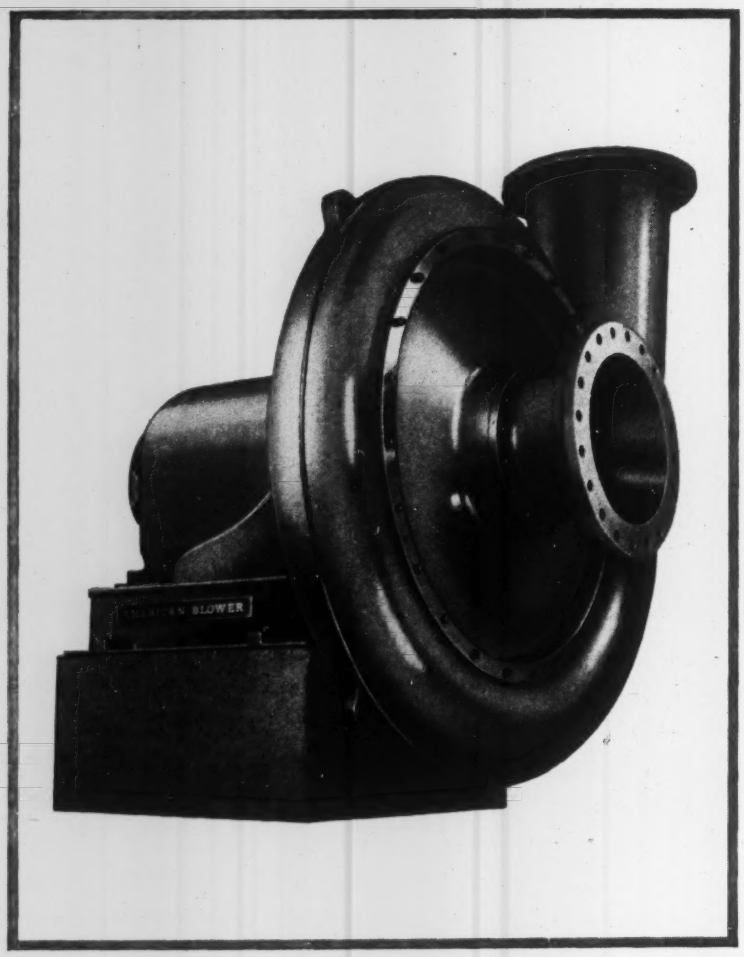
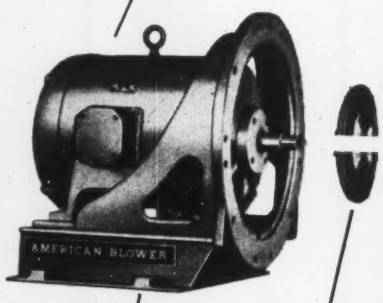


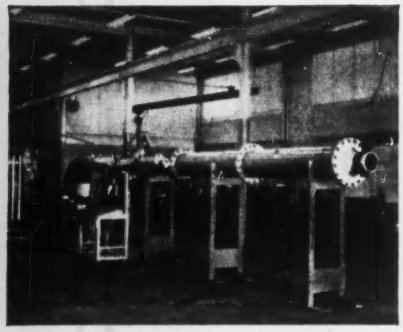
Motor — Standard NEMA construction. Short motor shaft extension and conservative impeller loads assure operation below first critical speed of rotor assembly.



Baseplate — Heavy welded-steel baseplate structures assure rigidity and accurate alignment.

Shaft Packing — Nonferrous, cast construction. No mechanical contact between stationary and rotating parts.

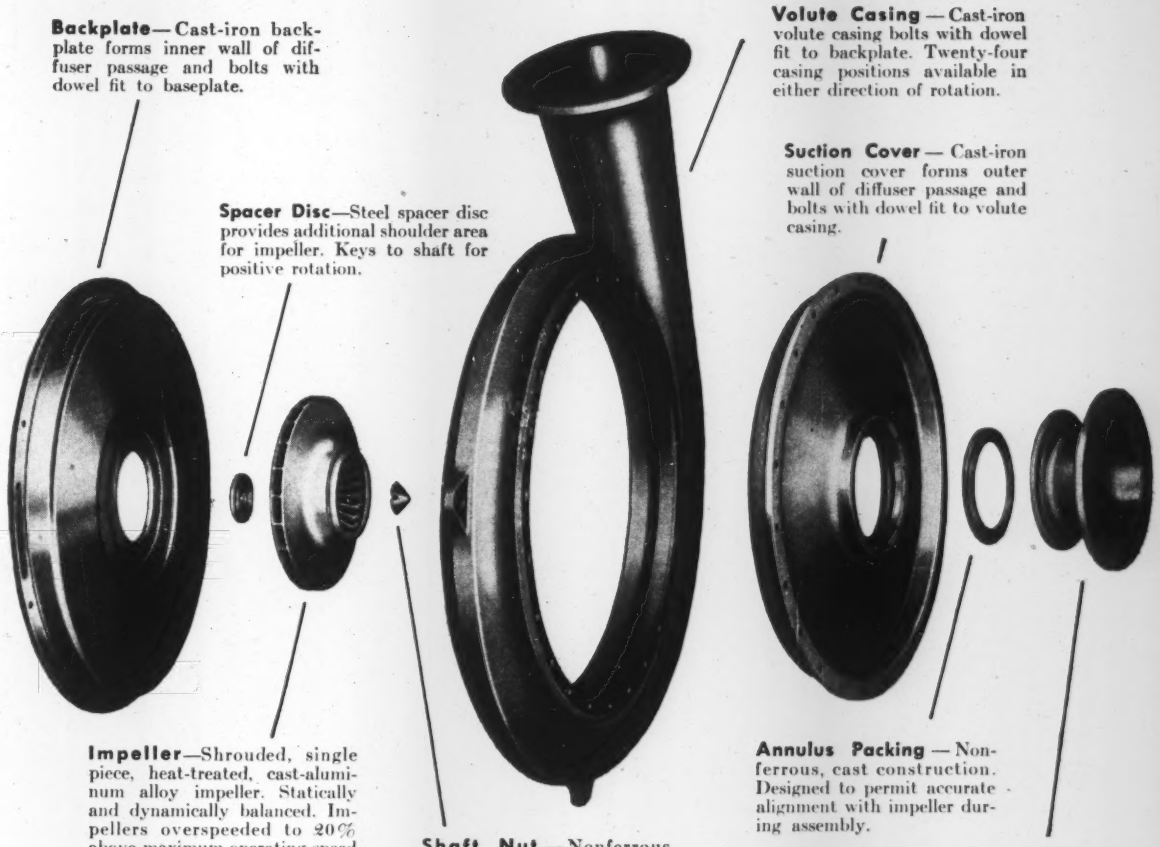
AMERICAN BLOWER offers you an outstanding



Prior to shipment, each compressor is thoroughly tested for mechanical and performance characteristics in accordance with the A.S.M.E. Power Test Code in American Blower's modern research and testing laboratory.

APPLICATIONS

- Air compression
- Annealing furnaces
- Catalyst regenerators
- Coal pulverization
- Cupolas
- Forging furnaces
- Gas boosters and exhausters
- Pneumatic conveying
- Oil-gas generators
- Plant pressurizing
- Sintering
- Water-gas generators



Backplate—Cast-iron backplate forms inner wall of diffuser passage and bolts with dowel fit to baseplate.

Spacer Disc—Steel spacer disc provides additional shoulder area for impeller. Keys to shaft for positive rotation.

Impeller—Shrouded, single piece, heat-treated, cast-aluminum alloy impeller. Statically and dynamically balanced. Impellers overspeeded to 20% above maximum operating speed before assembly. Impeller keys to shaft for positive rotation.

Shaft Nut — Nonferrous, streamlined shaft nut permits uniform flow of gas to impeller inlet.

Volute Casing — Cast-iron volute casing bolts with dowel fit to backplate. Twenty-four casing positions available in either direction of rotation.

Suction Cover — Cast-iron suction cover forms outer wall of diffuser passage and bolts with dowel fit to volute casing.

Annulus Packing — Nonferrous, cast construction. Designed to permit accurate alignment with impeller during assembly.

Inlet Nozzle—Cast-iron construction designed to provide uniform gas distribution. Flanged for standard pipe connections.

line of CENTRIFUGAL COMPRESSORS

You can buy American Blower Single Stage Compressors in sizes from 30 to 600 HP, with pressures from 1¼ to 3¾ lbs. They're designed to deliver efficiently large volumes of air or gases. Capacities range from 4,000 to 28,000 c.f.m. Get complete technical data from the nearest American Blower Branch Office or write us for Bulletin 109.

Whether you need equipment for heating, cooling, ventilating, air conditioning, vapor absorption, fume removal, dust collecting, mechanical draft, heat transfer or smooth power transmission thru Gyrol Fluid Drives — American Blower manufactures a complete line of products to meet your requirements. Helpful technical literature is available on each product.

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valve values
PHOTO NEWS

Incubator for Ideas

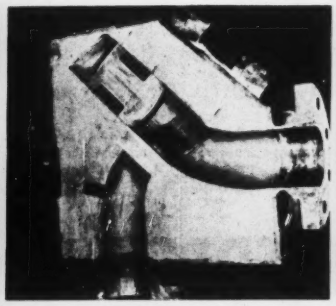
Edward's new Engineering Building, above, symbolizes the pride we take in our engineering staff. To house these men—whom we believe to be the most talented and experienced group of valve engineers to be found anywhere—we've constructed this building specially designed to permit them to operate at their highest possible efficiency. For example, the Engineering Building is immediately adjacent to our laboratories, permitting frequent and immediate consultation between engineers working with specific design problems, and laboratory research scientists.

Together, engineering and research maintain a rigid step-by-step control over all Edward operations. Nowhere is this more evident than in the development of a new valve to meet a customer requirement. Let's take a brief look at some of the steps in the production of one of Edward's latest designs.

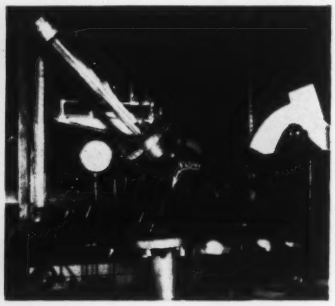
THE PROBLEM: **A prominent boiler manufacturer was designing a new unit to obtain increased efficiency from more rapid circulation of water within the boiler. They proposed to control this circulation by specially designed pumps. Special stop-check valves with absolutely tight shut-off characteristics were required to protect these valuable pumps from back flow of water from the boiler. Because of the low differential pressure in the circuit, pressure drop across the valve had to be kept to an absolute minimum.**

Product development committee first explored the problem thoroughly, then initiated a project . . .

. . . in research laboratory to determine basic fundamentals of design which were finally expressed in . . .



. . . plastic half models which were tested on flow machines. Lessons learned here were incorporated in . . .



. . . ¼ scale steel model given regular operating tests which suggested refinements for . . .

Edward Valves, Inc.

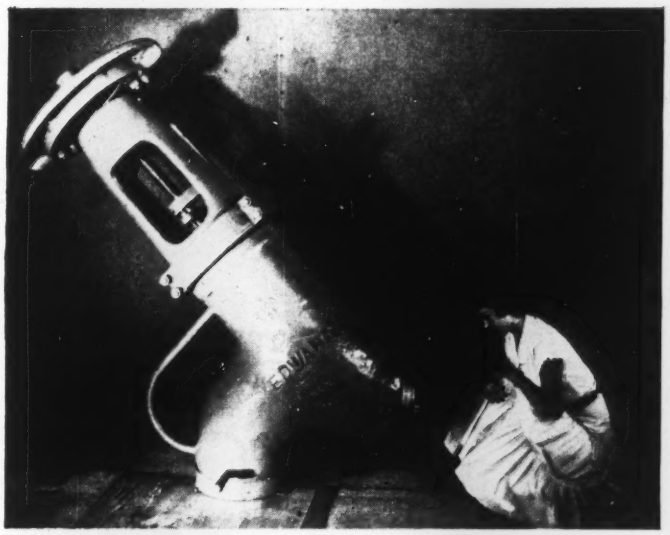
Another Product

. . . final full scale experimental model which was tested on complete flow hookup. Passing with flying colors . . .

. . . the new model went to engineering for final determination of production techniques to be used and. . .

. . . detailed drawings for machinists and inspectors were made for use in actual production . . .

. . . where it was under the constant supervision of inspection services guided by the Engineering Department. Finally we could deliver to the customer . . .



THE SOLUTION: The new stop-check valve pictured above. Developed in 10 in. and larger sizes for boiler pressures from 1500 to 3000 lbs, this new valve easily meets the rigid requirements of perfect shut-off and minimum pressure drop. In addition, the original piping design called for a valve and elbow. A special design was evolved incorporating both of these into the valve, thus eliminating an elbow and weld at a substantial saving to the customer.

EDWARD VALVES, Inc., *Subsidiary of*

ROCKWELL MANUFACTURING COMPANY

1350 W. 145th STREET • EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

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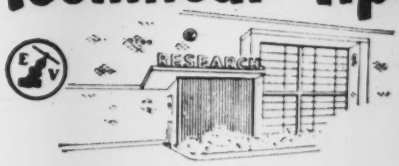
Technical Tips



Closing Torques for Globe Valves Against High Pressures

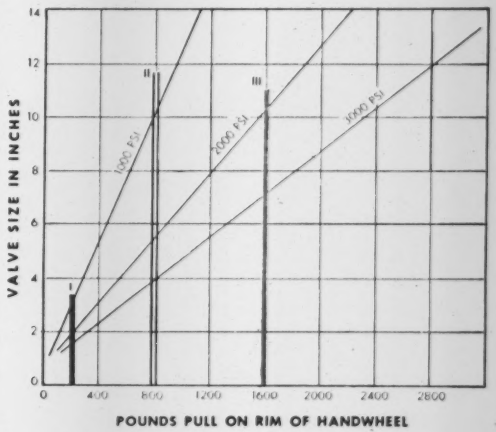
Where tight closure on high pressure lines is absolutely essential, globe valves are usually selected in preference to other valve types.

However, a simple calculation will show that it is almost impossible for one man to close a large globe valve on a high pressure line without some sort of mechanical aid. Edward provides this required mechanical advantage in the simplest, most inexpensive form through the highly effective Impactor handwheel.

In a globe-stop valve, the torque on the handwheel rim must be sufficient to generate a downward force in the valve stem at least equal to the pressure to be held under the valve disk times the area of the disk. This force varies directly with size and operating pressure. Deviations also arise from differences in the trueness of the two mating seating surfaces, packing friction, stem thread friction, and the ratio of stem diameter to handwheel diameter.

The chart below shows the approximate theoretical steady pull required on the rim of a handwheel to create a tight seat in Edward high pressure globe valves with operating pressures of 1,000, 2,000 and 3,000 pounds.

The average man cannot pull more than about 200 pounds on the rim of a handwheel. Therefore, some sort of supplementary closing device is needed for the pressures covered on our chart, in almost the complete range of valve sizes.



I. Limit of closing torque one man can exert by hand.

II. Torque one man exerts with ten blows of 12" Impactor Handwheel.

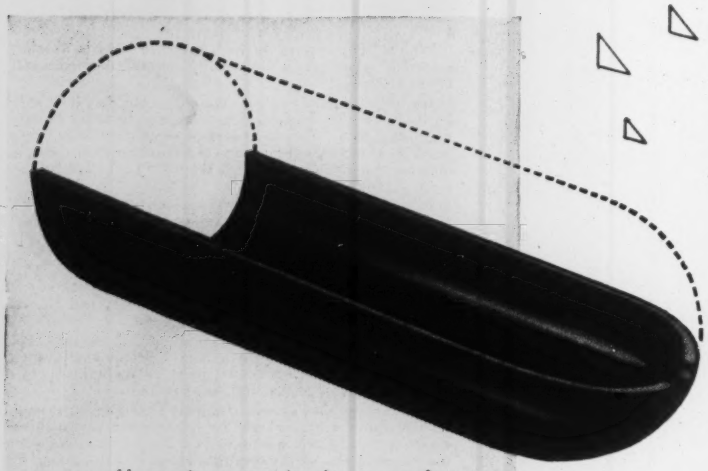
III. Torque one man exerts with ten blows of 36" Impactor Handwheel.

Lines II and III on the chart show the closing effect obtained by one man with two different sizes of Impactor handwheels. Line II shows the closing torque exerted by ten blows of a 12 in. Impactor handwheel, namely, four times the effect which would be obtained by the same man exerting only a steady pull. Line III shows the closing torque exerted by ten blows of a 36 in. diameter handwheel, eight times the unaided closing torque.

For some combinations of higher pressures and larger valve sizes on the chart, ten blows of either handwheel does not indicate complete closure. Additional blows with the Impactor will readily obtain drop tight closure in each case.

Edward

How Tubular Parts with Formed Ends Can be Produced most **ECONOMICALLY**



Here is a typical case of economy. Shown is a section of a cylindrical part now made in one piece from Wolverine tube with both ends almost closed by means* of the Wolverine Spun End Process.

Having no seams or joints, this redesigned part offers assurance against leaks; and makes the complete unit more dependable at all times.

This product was formerly made from a cylindrical form capped at both ends and silver soldered at the joints.

*A PATENTED PROCESS RE. 22465.

Tubular parts requiring tapered, rounded, flat or other shaped ends can be made easily, quickly and economically by the Wolverine Spun End Process*.

By virtue of their improved design, the finished parts made by this process perform more efficiently, and their modern lines add to the sales appeal.

This streamlined design also has the advantage of eliminating several parts, thereby reducing labor and material costs and assembly time as well.

A request on your letterhead will bring you a copy of our brochure "Spun End Process."

Other Wolverine Products

CAPILATOR*
—the capillary tube for restriction purposes
COMMERCIAL TUBE
AUTOMOTIVE TUBE
CONDENSER TUBE
COPPER WATER TUBE (K-L-M)
ELECTRIC WELDED STEEL TUBE
FABRICATED TUBULAR PARTS
WOLVERINE TRUFIN*
—the integral finned tube
REFRIGERATION AND AIR CONDITIONING TUBE
(Plain or Tin Plated)
S.P.S. PIPE
SPUN-END TUBE†

*Reg. U.S. Pat. Off.
† A Patented Process RE 22465

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario

WOLVERINE TUBE DIVISION
of CALUMET & HECLA, INC.

ESTABLISHED 1916

Manufacturers of Tubing Exclusively

1437 CENTRAL AVENUE • DETROIT 9, MICHIGAN

Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

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LINK-BELT Research and Engineering . . . Working for Industry

Thousands of tiny steel balls pound extra life into this chain

Here is how the rollers of Link-Belt Roller Chain are "cold worked" —by shot-peening—for added ability to withstand shock and impact.

LINK-BELT shot-peens the rollers of its roller chain for greater shock and impact capacity

TO TRANSMIT today's heavier loads at higher speeds, modern roller chain must withstand severe, continuous impact. From scores of service reports, Link-Belt engineers discovered that the rollers which contact the sprocket teeth were a critical member in many cases.

To make a good product even better, Link-Belt metallurgists developed a method of shot-peening the rollers which greatly increased their fatigue life. So effective are the results that industry has learned to look for darkened rollers as evidence of shot-peening.

This added manufacturing process is one of several that build extra life into Link-Belt Precision Steel Roller Chain. It's another example of how Link-Belt research and engineering work for industry.

Back of every Link-Belt conveying and power transmission product are many years of field and laboratory experience. That's why these broad lines are known throughout industry for efficient, long life under the toughest service conditions.

LINK-BELT COMPANY

Executive Offices:

307 N. Michigan Ave., Chicago 1, Ill.

Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities.

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LINK-BELT

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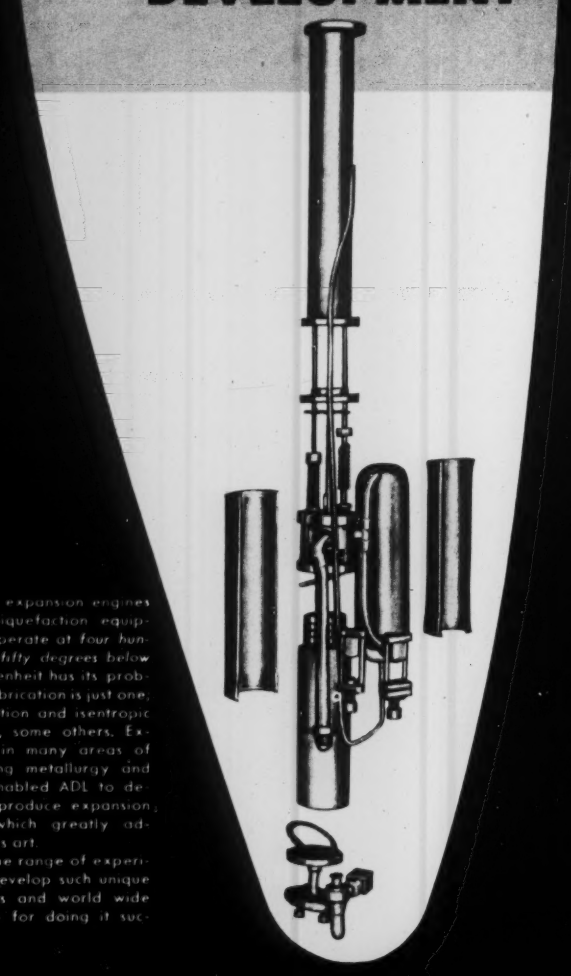
UNIQUE
PROTOTYPE DEVELOPMENT

. . . using advanced Engineering Techniques

New ADL Mechanical Division Building



Designing expansion engines for gas liquefaction equipment to operate at *four hundred and fifty degrees below zero* Fahrenheit has its problems — lubrication is just one, contamination and isentropic efficiency, some others. Experience in many areas of engineering metallurgy and physics enabled ADL to design and produce expansion engines which greatly advanced this art.
ADL has the range of experience to develop such unique prototypes and world wide reputation for doing it successfully.

IF lack of personnel has halted development of your new ideas or new products, the ADL Mechanical Division can take over and bring them to complete maturity.

Arthur D. Little, Inc., has blended its scientific and engineering skills in the Mechanical Division to provide industry with a unique service . . . prototype development of equipment requiring a high level of engineering. Scientists in the fields of chemistry, physics, metallurgy, mathematics, biology, electronics and technical economics can be called on as required.

Our staff is experienced in interpreting the ideas of industry and following through with the perfection of specialized equipment.

THERMODYNAMICS · HEAT TRANSFER · REFRIGERATION TO MINUS 456 F. · VACUUM ENGINEERING · GAS LIQUEFACTION · ELECTROMAGNETISM · MECHANICAL DESIGN · VIBRATION

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Arthur D. Little, Inc.

CREATIVE TECHNOLOGY SINCE 1886

ADL Mechanical Division

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MAXITORQ

automatic

OVERLOAD RELEASE

CLUTCH

To designers and manufacturers of high-speed automatic machinery, Carlyle Johnson offers practical engineering recommendations for applications of this protective power transmission unit.

Let's consider, for instance, a can or bottle labeling machine . . . when an accidental overload shock occurs. Labels go flying all over the place, cans or bottles gang up and are dented or broken, the driving mechanism is jammed . . . and all that costs money and down-time.

But not if your original power transmission is controlled by the Maxitorq automatic Overload Release Clutch, which is manually adjusted to transmit the normal running load and instantly disengages into neutral when the overload strikes. With a minimum of clean-up, the clutch is re-engaged . . . and all is well.

Overload Release Cups (note the cam construction) are the means by which the clutch is connected to the driven or driving member. We make them at relatively low cost . . . and can also supply hub, ring, flange, or cut-off coupling types to suit your specific conditions. Clutches standardized in 6 sizes, ¼ to 5 H.P. @ 100 r.p.m.; working torque, 13 to 263 ft. lbs.

Send for Bulletin #150—ME-3

THE CARLYLE JOHNSON MACHINE CO.

MANCHESTER . . . . . CONNECTICUT

3C/53

Frankly

SPEAKING

There are quite a few types of clutches but, within its capacity, the Maxitorq Floating Disc Clutch is not excelled in applications for which it is intended. The Carlyle Johnson Machine Company is celebrating its 50th anniversary of clutch manufacture. Throughout those years, our engineers have developed new design features, more and more compact construction, improved wearing qualities, and better machining practices for maintaining reasonable costs.

Perhaps the outstanding design feature is the patented "Separator Springs," a definite improvement that moved multiple disc clutches up to the front line. Used between each pair of inner discs, they spread them endways with an accordion action, so that light may be seen between all discs when the clutch is in neutral. Therefore, there is no drag, no abrasion, no heating. The discs actually "float" or ride free when the clutch is in the neutral position.

Carlyle Johnson's method of finishing the engaging faces of the discs assures flat, true surfaces. This means that under engagement there are no high or low spots . . . the entire area of the surfaces has an evenly distributed contact. Obviously, disc service life is greatly extended. Such refinements are the result of continuous study by our engineers to make and keep the Maxitorq name high on the list of machine and product designers for their original equipment for control of power transmission.

Your problems are in good hands if you put them up to our engineers for solution. We've traveled the country over to check on the best and most practical installations . . . and we're on call whenever a problem arises. Just ask for Frank R. Simon, The Carlyle Johnson Machine Company, Manchester, Conn

He Went Out to Meet Them

WITH FLARES AND WHISTLES and blaring bugles, the Reds had been attacking fanatically all night. Wave after wave they came, in overwhelming numbers.

By dawn, Jerry Crump could see that his position alone was keeping them from overrunning L Company. Twice he went out to meet them with his bayonet. Once he retook a captured machine gun. And four times he left shelter to bring in wounded comrades.

Now, an enemy soldier crept close unobserved. He lobbed a grenade. It landed squarely among the wounded men. Without a second's hesitation, Corporal Crump threw himself upon it, smothered the explosion with his own body, and saved his four companions' lives.

"I got hurt," says Jerry Crump, "but I got back alive. Because our armed forces have the finest medical equipment in the world—even at the front. And *you* helped put it there by investing in United States Defense Bonds."

Bonds are savings. But they mean *production power*, too. Helping provide the arms and equipment and care of every kind that give a fighting man *more* than a fighting chance.

Corporal Jerry Crump U.S. Army Medal of Honor

Now E Bonds pay 3%! Now, improved Series E Bonds start paying interest after 6 months. And average 3% interest, compounded semiannually when held to maturity! Also, all *maturing* E Bonds automatically *go on* earning—at the new rate—for 10 *more* years. Today, start investing in United States Series E Defense Bonds through the Payroll Savings Plan at work.

Peace is for the strong! For peace and prosperity save with U.S. Defense Bonds!

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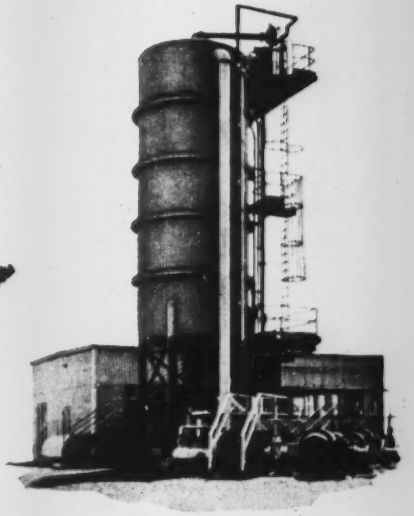
DEAERATED COOLING WATER SAVES ONE COMPANY

$85,500 a year!



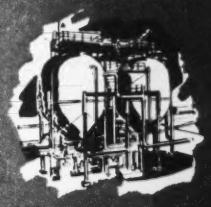
REDUCES CORROSION RATE 90%
PREVENTS TUBERCULATION
CUTS TUBE REPLACEMENTS
LOWERS WATER CONSUMPTION

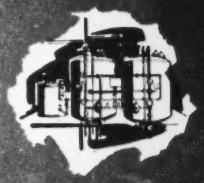
A chemical company in California installed a Permutit 5,000 gpm Vacuum Deaerator just over 2 years ago. Now here's what they have to say about it after exhaustive checking and comparison.

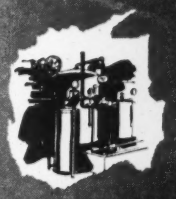
"The benefits occurring from water deaeration are difficult to calculate in their entirety, since so many of the advantages in small items such as clean water lines, better operation of valves, less frequent water line replacement and better water flow cannot be easily assessed. However, the major corrosion costs in this plant . . . have been determined and compared with the cost of deaeration . . ."

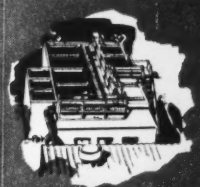
And the report goes on to cite actual net savings of $85,500 per year resulting from the installation of a Permutit Vacuum Deaerator.

Find out how Permutit can solve *your* water problems. Write to THE PERMUTIT COMPANY, Dept. ME-3, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.









WATER CONDITIONING HEADQUARTERS FOR 40 YEARS

PERMUTIT®

The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.

T F

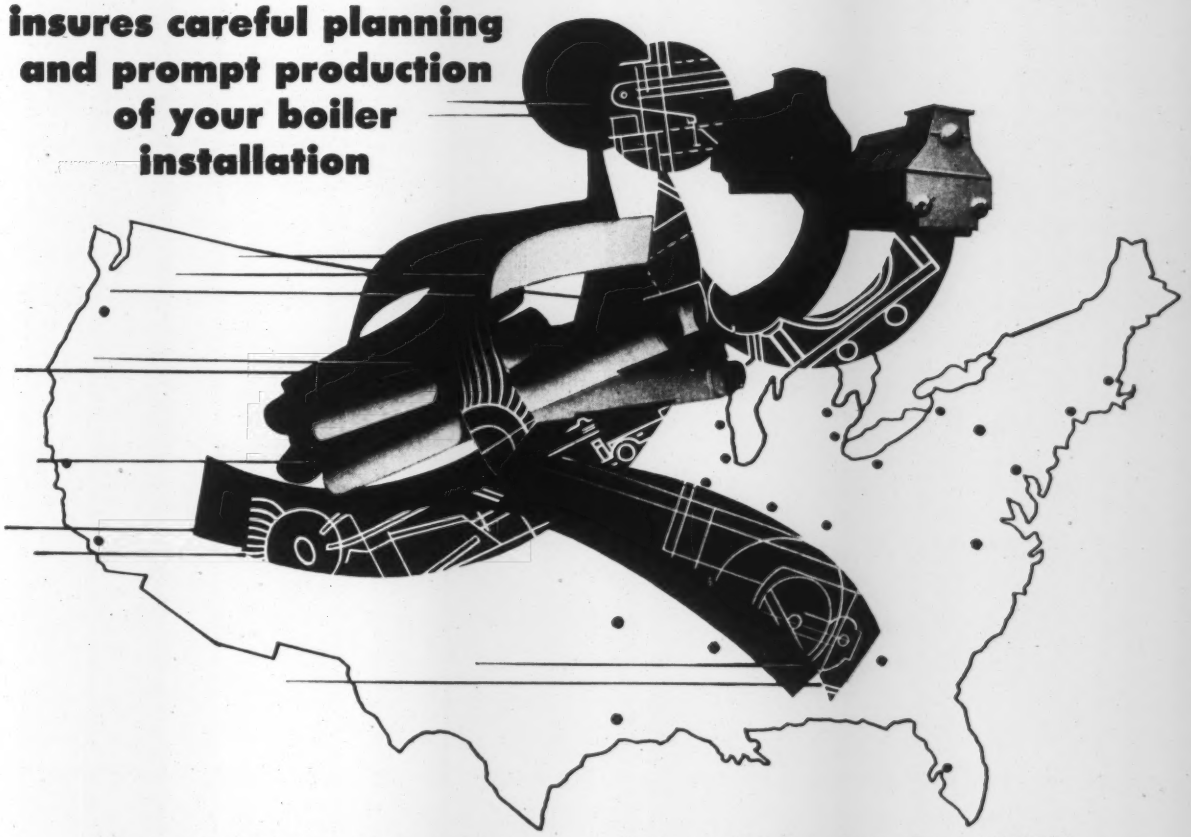
For up-to-the-minute facts, see your Taylor Forge distributor

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

WICKES SERVICE

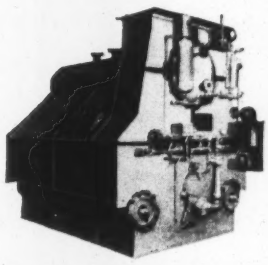
insures careful planning and prompt production of your boiler installation



When you need steam generating equipment, you want to be able to work out your requirements with experienced men who are near at hand and know boilers thoroughly. That's where WICKES can help you, because WICKES has factory-trained sales engineers in twenty-three principal cities in the United States and several industrial centers outside the country. These men are ready to help you plan your new boiler installation.

And when your plans are settled, you want your equipment installed as soon as possible. That's when WICKES engineers and production men swing into action. They rush to get your new boiler installation ready in a hurry. WICKES handles all the details—from the time the first drawings are made to the day you raise steam pressure. Then, for the life of the boiler, WICKES sales engineers and maintenance men are available day and night to keep your equipment operating at peak efficiency.

WICKES can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers, adaptable to any standard method of firing. Write today for descriptive literature or consult your nearest WICKES representative.



WICKES THE WICKES BOILER COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

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146

WHAT *Life-Line* REALLY DELIVERS IS MORE SERVICE...LESS SERVICING

"Whips Trouble Spots" Say users of these *Life-Lines*

"Neither Vibration Nor Moisture Are Problems Now," says the Richard Ore Co. "We installed 7 Westinghouse Life-Linestarters® in a particularly difficult application, a mine concentrating mill. We were off to a flying start immediately—the Westinghouse Life-Linestarter is easier to install because of straight-through wiring and the arrangement of breaker and starter in a single enclosure. Outages due to moisture and vibration have been virtually eliminated. That had been our biggest headache . . . more Life-Lines will be installed shortly."

"No Motor Failures of Any Kind, Now," says Watchcase Manufacturer. "Our punch-press motors were 14 feet off the floor . . . just high enough so that lubrication was often 'forgotten'. Frequent bearing failures and burnouts resulted until we 'perched' pre-lubricated Life-Lines up there two years ago. Since then . . . no failures of any kind. We've standardized on Life-Lines."

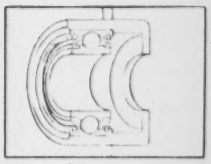
"Straight-Through Wiring Answered My Problem," says the Baker Refrigeration Corp. "We have a new air-conditioning design that requires the use of two starters. We found that the Westinghouse Life-Linestarter could be more easily mounted in a group within our enclosure—saved assembly labor. This completely sold me on your straight-through wiring."

"Increase Bearing Life 8 Times," says Oak Hill Firebrick Co. "We were using sleeve-bearing motors on a shaker screen in a firebrick plant. Bearings never lasted over six months. Life-Lines installed over four years ago have been running 16 hours a day ever since. Pre-lubricated bearings have been perfect."

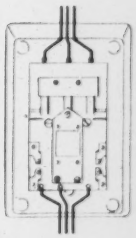
Typical? Yes. Typical of hundreds of reports in every industry. Why not install these dependable partners on your machines? A check with your Westinghouse representative will bring you full details. Ask for copies of "Life-Line Motor Case History Book", B-4769-A and "Tomorrow's Starter Today", B-4677, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21697-A

YOU CAN BE SURE...IF IT'S

Westinghouse



Needs no lubrication. Pre-lubricated, factory-sealed bearings eliminate troubles due to under or overlubrication, dust and dirt.



Straight-through wiring. Three line terminals at top; three load terminals at bottom—all easily reached from front.

Bonderite-protected starter enclosure. Anchors enamel as if it were part of steel itself. Finish will not blister or corrode.

For all those engaged in production work

MANUAL ON CUTTING OF METALS

Providing, in 545 pages, a comprehensive coverage of all phases of machinability with respect to single-point cutting tools.

Written in collaboration with twenty-two specialists, this new Second Edition of the Manual enlarges upon the first (published in 1939) in that it incorporates a more descriptive presentation of tool materials and their treatment; of work materials and the relations of their behavior and properties to microscopic structure; and much new material on the types, purposes, and application of cutting fluids.

Additionally, there are extensive new tables giving both unit horsepower and machinability ratings for a great number of steels of various hardnesses for specific tools and cuts; and charts for determining the speeds for further combinations of cut, tool shape and material hardnesses. Specifications for many of the materials covered in the new tables are for the most recent revisions of mechanical properties.

The tabular data on cutting speeds and horsepower of the first edition are retained because of their comprehensiveness.

SHOPMEN will find in this Manual the ready information they want.

PRODUCTION EXECUTIVES can look to it for help in selecting the structure of metals to be machined, the correct tool material, the size and shape of cut, the proper cutting fluid, and in predetermining the power requirements and best operating speeds for all jobs.

TIME STUDY MEN can use its data on optimum cutting conditions to formulate operating standards and predict production costs.

All this information has been gathered in one compact volume for your use.

- Types, uses and preparation of single-point tools—American Standard nomenclature, standard types and sizes of tools, tips, inserts, and holders; tool materials, grinding, evaluating tool performance.
- Mechanical characteristics and structures of work material—Influence of metallurgical structure on machinability, chip formation and control, factors influencing surface finish.
- Definitions, functions and classification of cutting fluids—Influence on cutting speeds, best ratio of depth to feed, practical cutting fluid recommendations.
- Cutting forces; gross and net power at the cutter—Tools, speeds and feeds for machining a variety of metals, including high nickel alloys, stainless steels, copper alloys, cast iron, and plastics.
- Net unit power for machining a great number of metals using a single size of cut—Formulas for computing power required for other cuts, correction factors for various tool angles, computation of motor capacity requirement.
- Economics of metal cutting—Costs of cutting, idle and loading time, tool changing, and grinding; cost per piece formula, calculation of minimum cost per piece, and of tool life for maximum production rate.
- Tabular data—Specifically 322 tables covering the machining of thirty-five commonly used steels by seven differently shaped tools; the cutting speeds and the horsepower required for seven speeds varying from 0.002 to $^1/_8$" each for nine depths ranging from $^1/_{32}$ of an inch to one inch; an extensive table from which values may be derived for a more complete list of 289 steels and conditions; and other tabular data for computing similar information about the furning of 27 cast irons and 34 nonferrous metals.

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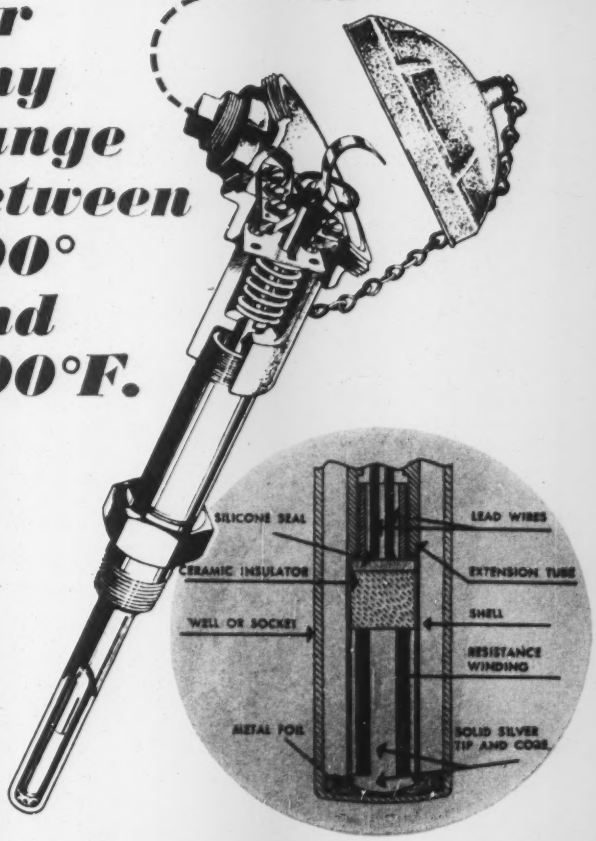
You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between–100° and+600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

The Dynatherm Resistance Bulb has unique features including metal-to-metal end-contact which, when installed in a well or socket, gives a speed of response unsurpassed by any other similarly protected temperature-sensitive element. Exceptionally rugged and permanent in calibration.

These are only a few of the important advantages of this better temperature measuring system . . . available also for control of temperatures, or with Multi-Record Dynalog Recorder for up-to-6 records on one chart. Write for illustrated bulletins, The Foxboro Company, 963 Neponset Ave., Foxboro, Mass., U.S.A.

for any range between -100° and +600°F.



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LUBRICANT TUBE KEY

Actual size of key supplied with each tube.

GUN LUBRICANT TUBE

Actual size of gun lubricant tube for Nordstrom valves.

BULK LUBRICANT TUBE

Actual size of bulk lubricant tube for Nordstrom valves.

IN TUBES!

FOR LUBRICANT SCREW AND LUBRICANT GUN USE

SIMPLEST, CLEANEST, MOST ECONOMICAL METHOD OF VALVE LUBRICATION

The new Rockwell lubricant tubes were developed to provide a better means of lubricating Nordstrom valves. They are a big time and money saver for maintenance departments; a great convenience to supply stores.

For Nordstrom valves equipped with lubricant screws, you just insert tube spout in the valve shank and turn key until lubricant chamber is filled. It's easy and quick! The lubricant is always kept fresh . . . no chance for contamination by dirt or grit. The inventory problem is simplified—one tube fits all sizes and types of Nordstrom valves.

If you lubricate Nordstrom valves by lubricant gun, then specify the new Rockwell gun tube. Insert it in your gun and turn the key until all lubricant has been emptied into the barrel. The whole job takes only a few seconds.

Rockwell bulk lubricant tubes are normally packaged in boxes of four; however, single tubes are also available. Gun lubricant tubes are supplied in boxes of six.

The most commonly used Rockwell Nordcoseal lubricants are now produced in tube, stick and bulk form. Other Nordcoseal lubricants and Hypermatic, the energizable lubricant, will still be available in stick and bulk form.

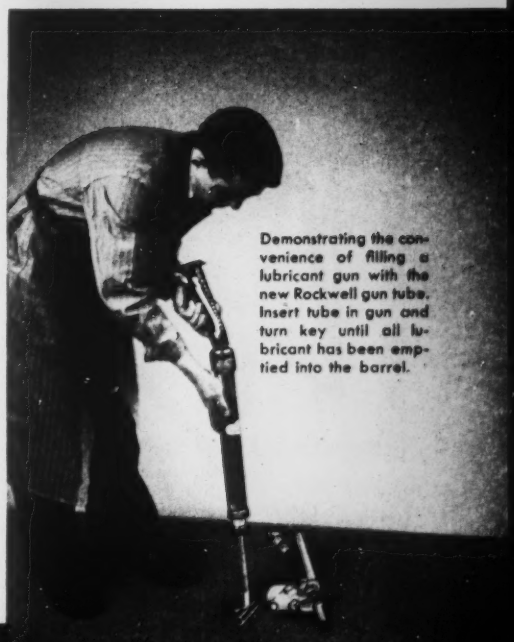
To assure positive valve closure, quick easy operation and longest valve life, use *only* genuine Rockwell lubricants in Nordstrom valves.

Write for bulletin V-220 describing Rockwell lubricants for Nordstrom valves. Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

ROCKWELL Built
Nordstrom Valves

Lubricant-Sealed for Positive Shut-Off

Maintenance man demonstrates ease of lubricating a Nordstrom valve with the new Rockwell bulk lubricant tube. Insert spout of tube in valve shank and turn key until lubricant chamber of valve is filled.



Demonstrating the convenience of filling a lubricant gun with the new Rockwell gun tube. Insert tube in gun and turn key until all lubricant has been emptied into the barrel.

4 reasons why Trane dry-type fluid coolers last longer

1 Correct metal selection

A wide variety of types of metals are available for highly corrosive applications. Coils can be supplied in combinations of cupro nickel, admiralty, red brass, copper, aluminum, monel, steel, stainless steel and many other special metals. TRANE engineered products have solved corrosion problems of all types, yet obtained maximum heat transfer and maximum life from the fluid circuit.

2 Permanently bonded fins

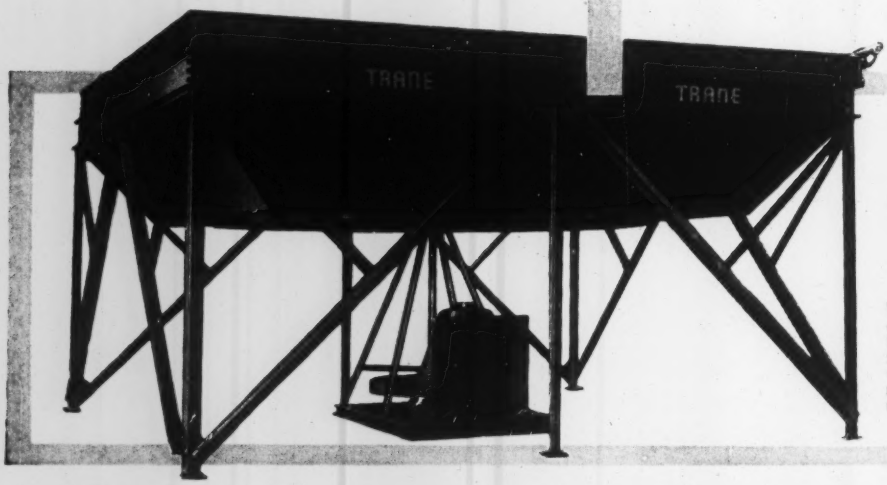
In constructing the Extended Surface Coil—heart of the fluid cooler—TRANE bonds fin to tube *mechanically*. This bond is as permanent as the metals that form it and as strong as though fin-and-tube were one. Heavy support plates are used to reinforce and protect the coil and prevent tube sagging. And the exclusive TRANE Guide Flange cradles the coil to permit expansion within casing.

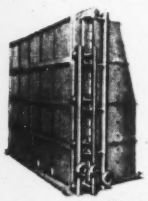
3 Extra-rugged construction

Framework of the TRANE Fluid Cooler is so strong it can be used for stationary or portable installation *without additional bracing*. Its simple structural design permits fastest possible erection. Yet it is more than strong enough to support core and accessories and withstand wind and shock load. Finish on the TRANE Fluid Cooler is a rubber-base paint that's completely weatherproof.

4 Freedom from vibration

TRANE Fluid Coolers run smoothly . . . quietly. They stay sound and tight longer because TRANE engineers have virtually eliminated the causes of vibration. Here's how: The variable-pitch fans are dynamically balanced. Solid, oversized fan shaft is firmly mounted in giant thrust bearings. Drive components are aligned at the factory and shipped assembled. Orifice ring is designed to *match* the fan.





Trane Dry-Type Fluid Coolers can be used profitably in hundreds of ways. Series GC for vertical discharge (shown above) is made in 6 regular sizes with fan diameters ranging from 72″ to 144″.

Jacket water cooling costs are cut to the minimum with the TRANE horizontal air stream Fluid Cooler. Series EC—available in 14 sizes with fan diameters from 18″ to 120″.

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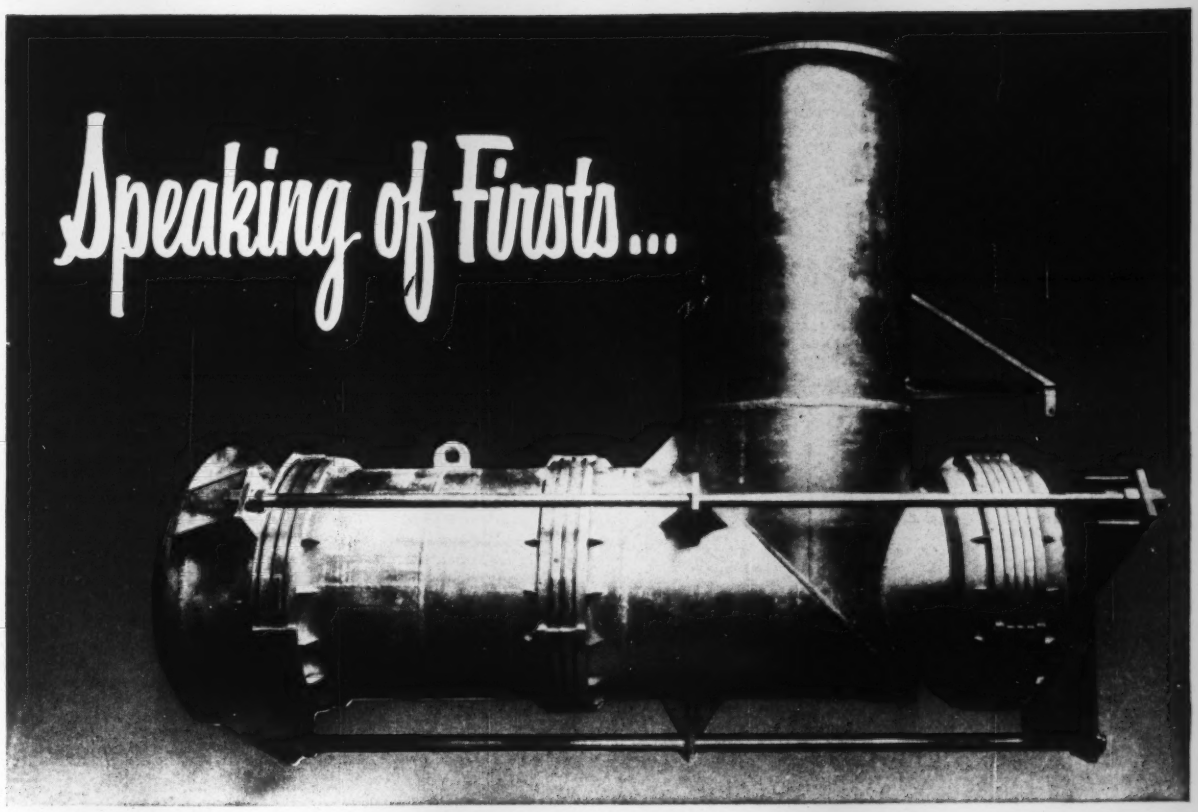

Recently, Zallea was given the assignment of developing a group of 48-inch expansion joints for flight propulsion test facilities on a classified defense project. The rigid technical specifications of this advanced application required "tailor-made" units for the job, so Zallea engineers analyzed the problem and designed the unusual-looking joint pictured above . . . the first of its kind. Actually, it is a Balanced Pressure, Universal Self-equalizing expansion joint, originally developed by Zallea engineers in 1945, operating at 165 psi and incorporating internal stainless steel turning vanes to provide a smooth flow of gases through the right angle bend. The unit absorbs 3" axial and 1.27" lateral movements through a temperature range from −100° F. to +650° F. No anchors are required since this arrangement neutralizes end thrust developed by internal pressures.

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Zallea Expansion Joints are available in diameters from 3 inches to 30 feet . . . for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs, and up to 2,000 psi in special designs.

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For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 351.

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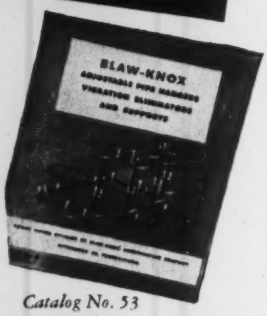
Type 9 Functional Assembly (illustrated) provides free rolling action in two directions and freedom of movement in three—lateral, vertical and horizontal. Its *internal swivel* action gives full control over all movements, and minimizes absorption of piping thrusts by the connecting flanges . . . a big help in keeping maintenance and replacement costs at rock bottom. Available for all standard size piping. Accommodates operating loads up to 12,000 lbs.



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BLAW-KNOX COMPANY
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MECHANICAL ENGINEERING

February, 1953 CARD INDEX Vol. 75, No. 2

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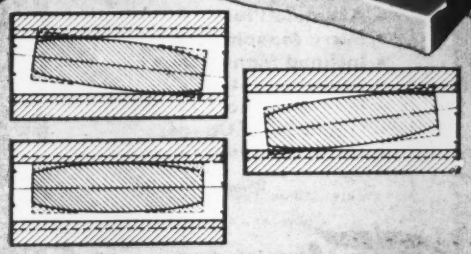
Oil Seals of Amerigear Couplings Are As Advanced In Design, Performance, And Effectiveness As Is The Amerigear Fully Crown Tooth. Pat. & Pat. Pending



Comparison Of Amerigear Fully Crowned Tooth Design With Gearing Of Conventional Gear-Type Couplings Shows How "End Tooth And Tip" Contact Is Practically Eliminated And Why Greater Freedom Of Axial Movement Is Provided By Amerigear Fully Crown Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

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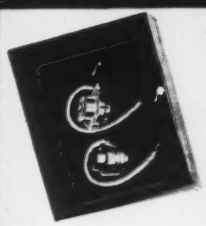

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ERIE, PA., U. S. A.

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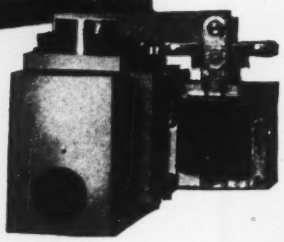

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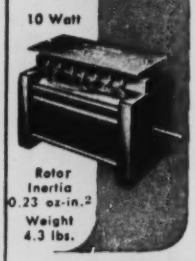

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with ZURN Engineered Low Pressure Drop STRAINERS

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Minimum open area ratio of 6 to 1 maintained even though selected basket material may be only 30% open.
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Zurn LPD Strainers are widely used to protect close-tolerance control devices and delicate mechanisms, also to protect product purity. They make continuous production processes possible.

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INDUSTRIAL DIVISION
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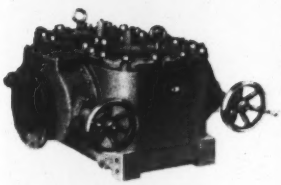
There is a ZURN LPD strainer for every fluid handling purpose



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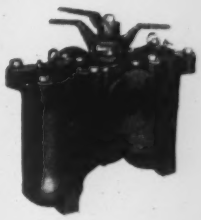
Zurn Sinlex Strainer. Available in offset and straight-through types.

Zurn "Y" Type Strainers available in any cast material and for high pressures.



Zurn Duplex Plug Type Strainer.

Zurn Engineered Low Pressure Drop Strainers are patented and patents pending.

WRITE FOR LPD STRAINER MANUAL DATA NO. 952

This manual includes previously unpublished pressure drop data and gives useful, factual information on fluid handling.

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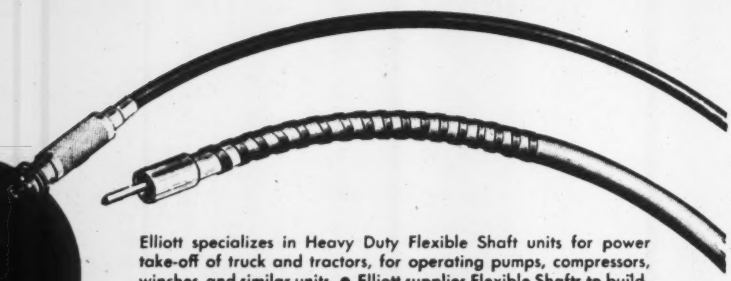

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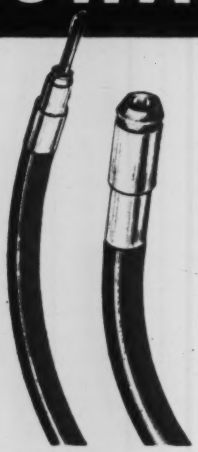

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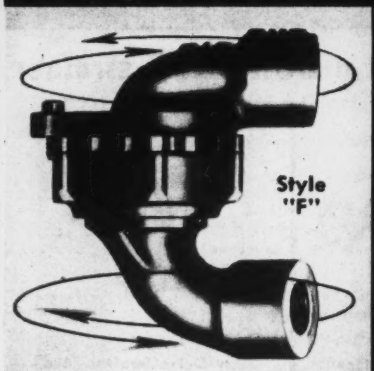

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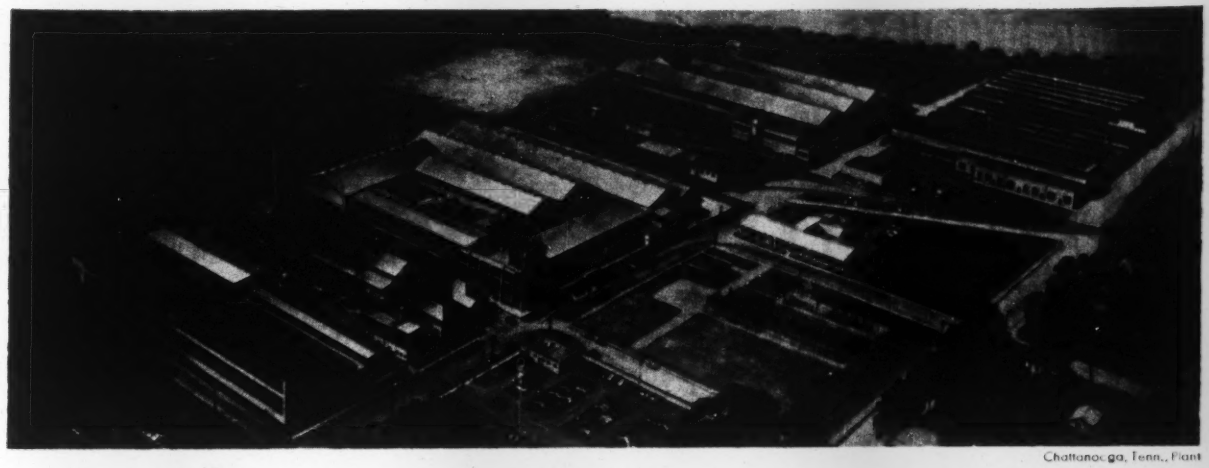

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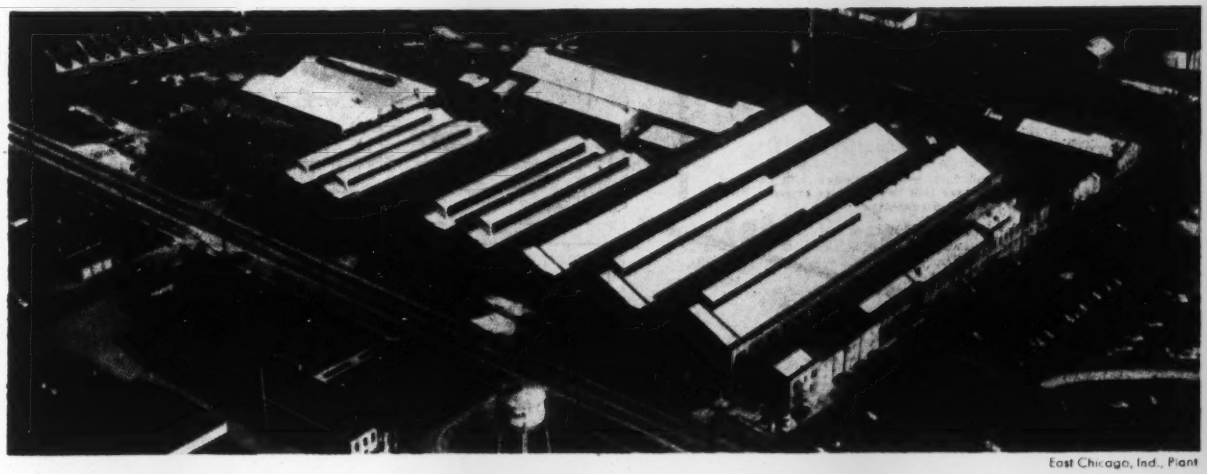

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Expansion of facilities has been the order of the day for years past at Combustion's plants in Chattanooga, Monongahela, Chicago, East Chicago and St. Louis. This expansion has been necessary to meet the ever increasing demand for the company's line of boilers and related equipment resulting from the vast growth of the power industry both in the United States and abroad.

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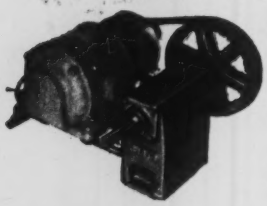

Available for fractional to 8 H.P. drives and speed ratios up to 3 to 1.

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ENGINE AND AIRPLANE CORPORATION
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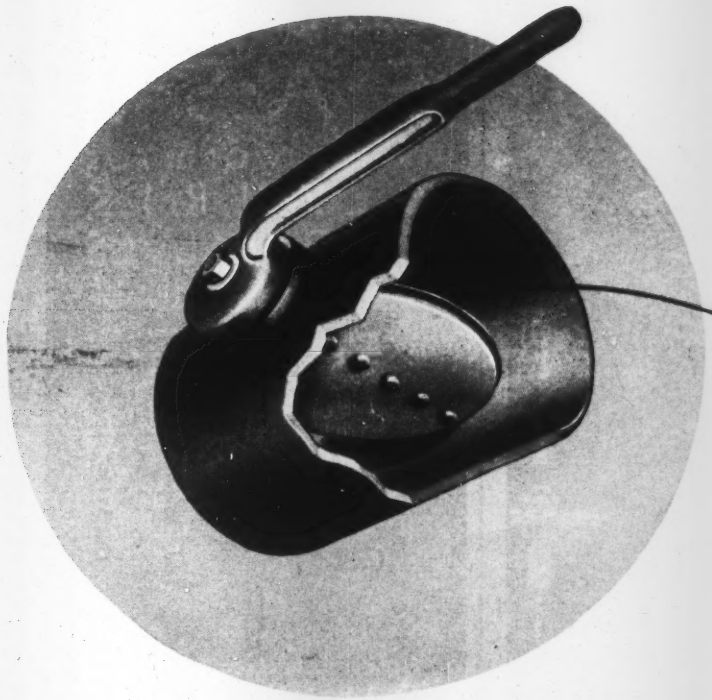

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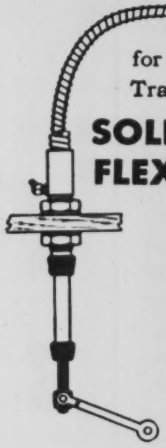

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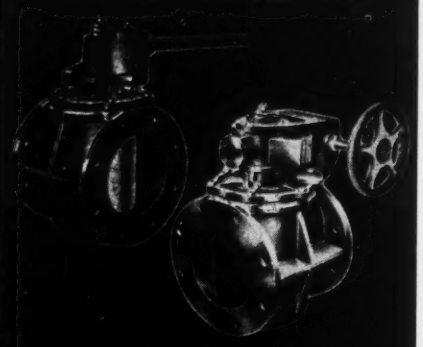

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Sartell, Minnesota

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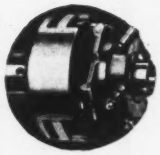

Work Winter and Summer

The TORO Snow Boy handles loose or packed snow — loading it into trucks or blowing it up to 65 feet. The TORO Grass King cuts up to 6 acres a day. ROCKFORD CLUTCHES transmit the power in these labor-saving units. Let ROCKFORD clutch engineers help design efficient power transmission controls for your machines.

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B-W PRODUCTION MAKES IT AVAILABLE

ENGINEERING BULLETIN SENT ON REQUEST

ROCKFORD CLUTCHES

When Reheat is Considered...

take a close look at this specific Kellogg experience!

To date the company's books show *36* reheat jobs both here and abroad. Some of these have been completed . . . several are underway . . . and others are yet to be started—but they all add up to a major percentage of all reheat systems—including those operating and those to be built.

In addition to this specific experience on, complicated reheat jobs, Kellogg approaches each new power piping project with a background that includes the fabrication of piping for scores of main steam installations which are today producing more than 6¼ million KWs...and operating at temperatures ranging up to 1050°F...and higher. One of the more recent jobs turned out in the Kellogg fabricating shops included the stainless steel main steam piping for a reheat system which will operate at 1100°F and 2350 psig.

The metallurgical "know-how" required to bend this material...to weld sections into fault-free sub-assemblies...and to accurately stress relieve is the result both of experience and specific development work. Kellogg pioneered special welding electrodes and special welding techniques for Stainless 347...and such work is one of the fundamental reasons why Kellogg is specified again and again by important companies for critical power piping jobs all over the world.

These leading companies are among the many major producers of power who use

M. W. KELLOGG POWER PIPING . . .

- American Gas & Electric Service Corp.
- Boston Edison Co.
- Central Hudson Gas & Electric Co.
- Chaudronneries A. F. Smulders (Belgium)
- Compania Argentina De Electricidad
- Compania De Fuerza Del Sureste De Mexico S.A.
- Consolidated Edison Co. of N. Y.

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FABRICATED PRODUCTS DIVISION
M. W. KELLOGG COMPANY

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SMALL TOOLS AND MACHINE TOOL ELEMENTS

American Standards

Published by

ASME

29 W. 39th St.
N. Y. 18

ACCURACY OF ENGINE AND TOOL ROOM LATHES, B5.16—1952. $1.00

This new Standard gives the tolerances to which industry is building 12 in. to 18 in., 20 in. to 32 in., and 40 in. to 72 in. lathes. Tests by which accuracy of the lathes may be determined are also given.

ADJUSTABLE ADAPTERS, B5.11—1937. 60¢

This standard gives the general dimensions of assembly, detail dimensions for adjustable adapter body, and general dimensions for adjustable adapter nuts, specifications for material finish, marking, and tolerances.

CHUCKS AND CHUCK JAWS, B5.8—1936. 55¢

Establishes controlling dimensions for all chucks from 6-in. to 36-in. diameter of both medium and heavy duty types, for an extra heavy series of chucks with serrated master jaws, for power-operated and hand-operated chucks of two-, three-, and four-jaw types.

CIRCULAR AND DOVETAILED FORMING TOOL BLANKS, B5.7—1948. 75¢

The 62 types of machines for which tool blanks and holders are provided are classified into six different groups of comparable stock capacities. Dimensions are given in this Standard for (a) circular tools with threaded mounting hole for groups 1, 2, and 3; (b) circular tools with counter-bored mounting hole for groups 4, 5, and 6; (c) dovetailed tools for all six groups, and (d) circular forming and dovetailed tool holders for all six groups.

DRILL DRIVERS (Split-Sleeve, Collet-Type), B5.27—1951 50¢

This Standard gives taper dimensions, general specifications, and the dimensions for 135 sizes of drill drivers along with the standard and optional taper number for each size.

INVOLUTE SPLINES, B5.15—1950. $2.00

Tables give dimensional and effective clearances, minor diameter fits, dimensions for both the flat root and fillet root types, basic measurements between and over pins, special pin measurements, and hob and broach dimensions. Provisions are made for allowable errors. Formulas are given for calculating pin measurements and torque capacities. Suggestions are included for placing dimensions and data on drawings.

INVOLUTE SERRATIONS, B5.26—1950. $1.00

Presents a uniform, easily fabricated set of serrations that can be made by several manufacturing processes. The pitches included are 10/20, 16/32, 24/48, 32/64, 40/80, 48/96, 64/128, 80/160, 128/256 complete from 6 to 100 teeth only for the first three. There are provisions for allowable errors and effective fits, new basic measurements between and over pins, and tables of maximum tooth space and minimum tooth thickness.

JIG BUSHINGS, B.56—1941, REAFFIRMED 1949. 50¢

Dimensions for: Press-Fit, Renewable-Wearing and Liner Bushings.

PUNCH AND DIE SETS FOR TWO-POST PUNCH PRESS TOOLS, B5.25—1950. 75¢

These dimensions are for back-post and diagonal-post sets. Tolerances established assure a high grade of tool which can be maintained commercially in respect to component parts and assembly. Dimensions cover die area, the die holder and punch holder thickness, shank diameters and lengths, guideposts and bushings, and removable punch holder shanks.

ROTATING AIR CYLINDERS AND ADAPTERS, B5.5—1932, REAFFIRMED 1949. 50¢

The four sizes of adapters standardized are: for the 3- and 4½-in. cylinders, the 6- and 8-in. cylinders, for all sizes of cylinders from 10 to 18 in., inclusive, for the 20-in. air cylinder or other power-operated device having a draw rod pull of 26,000 to 40,000 pounds. The length of stroke of the Standard cylinders, the position of the piston rod at the end of the stroke, the diameter of the piston rod, and the size of the tapped hole in the piston rod have also been standardized.

SINGLE-POINT CUTTING TOOLS AND TOOL POSTS, B5.22—1950. $1.25

Standard defines and illustrates the different classes of tools, their parts, and the angles at which they are used. Preferred dimensions are for: tool shanks, tool post openings, and lathe center height for solid tools and tool holders, six styles of sintered carbide tips (their commercial catalog numbers are also given), and the tips and shanks of tipped tools.

MARKINGS FOR GRINDING WHEELS, B5.17—1949. 50¢

Covering markings only, this Standard establishes a symbol for each of the most essential characteristics of a grinding wheel and arranges them in uniform sequence.

SPINDLE NOSES FOR TOOL ROOM LATHES, B5.9—1948. 85¢

These Spindle noses are for use on tool room lathes, engine lathes, turret lathes, and automatic lathes. Dimensions cover each size and type of nose; mating backs of chucks, face plates, and fixtures; and gages for checking important dimension on spindle noses and on back of chucks, face plates, and fixtures. There are instructions for drilling balancing holes for Type A spindle.

SPINDLE NOSES AND ARBORS FOR MILLING MACHINES, B5.18—1943, REAFFIRMED 1949. 50¢

Provides the essential dimensions for ends of arbor and adapter and for spindle nose, also dimensions for draw-in bolt end.

STRAIGHT CUT-OFF BLADES FOR LAT AND SCREW MACHINES, B5.21—1949 50¢

Dimensions here given are for the height, length, and thickness of the approved four types of blades. Sketches show optional shapes for cut-off blade stock.

T-SLOTS, THEIR BOLTS, NUTS, TONGUES, AND CUTTERS, B5.1—1949. 50¢

The primary purpose of this standard is to insure interchangeability. To accomplish this it recommends a width of throat greater than the nominal diameter of the bolt. It also provides an alternative standard having the throat width equal to the nominal diameter of the bolt. Other recommendations provide for the use of a stud of a smaller size than the T-bolt for the corresponding slot; that T-bolts, nuts, and slots be known by the diameter of the bolt; and for chamfering corners.

LIFE TESTS OF SINGLE-POINT TOOLS, B5.19—1946. 55¢

These test methods are for the appraisal of single-point cutting tools—for use on such machine tools as lathes, turret lathes, boring mills, planes, and shapers. These tests apply to speed, feeds, depth of cuts, shape and size of tools, Rockwell hardness, shape and size of test logs, etc.

TWIST DRILLS, B5.12—1950. 75¢

Provides dimensions for standard straight shank drills varying from 0.0135 to 2.000 in.; taper shank drills from ⅜ in. to 3½ in.; the corresponding drill lengths and flute lengths. Tolerances have been set on the various features of drills to provide interchangeability of products of different manufacturers in user's plants.

MACHINE TAPERS, B5.10—1943, REAFFIRMED 1949. 75¢

Presents (1) basic dimensions for 22 sizes of self-holding tapers; (2) detailed dimensions and tolerances for self-holding taper shanks and sockets classified as to (a) the means of transmitting the torque from spindle to shank of tool, and (b) the means of retaining the shank in the socket; (3) dimensions for steep tapers, and (4) dimensions and tolerances for the plug and ring gages applying to this series.

MACHINE PINS, B5.20—1947. 50¢

Sets up dimensions for the following types of pins: hardened and ground dowel pins, straight pins, ground dowel pins (not hardened), taper pins, clevis pins, and cotter pins. An appendix gives specifications for taper pins and a drill chart for the size of drill and number required.

MILLING CUTTERS, B5.3—1950. $2.25

Reflecting the developments in cutter design, tool material, and machine improvements are the 56 types for which dimensions are here given. Supplementing the dimensions are descriptive illustrations of the approved milling cutter and a glossary of terms.

REAMERS. B5.14—1949. $1.00

General dimensions of thirty standard types of reamers and related tools are presented along with the magnitude and direction of the tolerances including the number of flutes in the various types.

TAPS—CUT AND GROUND THREADS, B5.4—1948. $1.50

32 tables give the thread and general dimensions together with the working tolerances for nine types of taps. Supplementary material includes terminology and definitions and instructions for marking taps, dies, and other threading tools.

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Salary commensurate with ability and experience.

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STANDARD

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AT NORTH AMERICAN AVIATION

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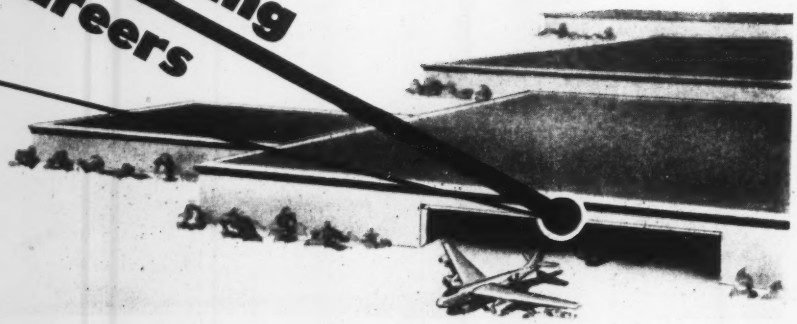

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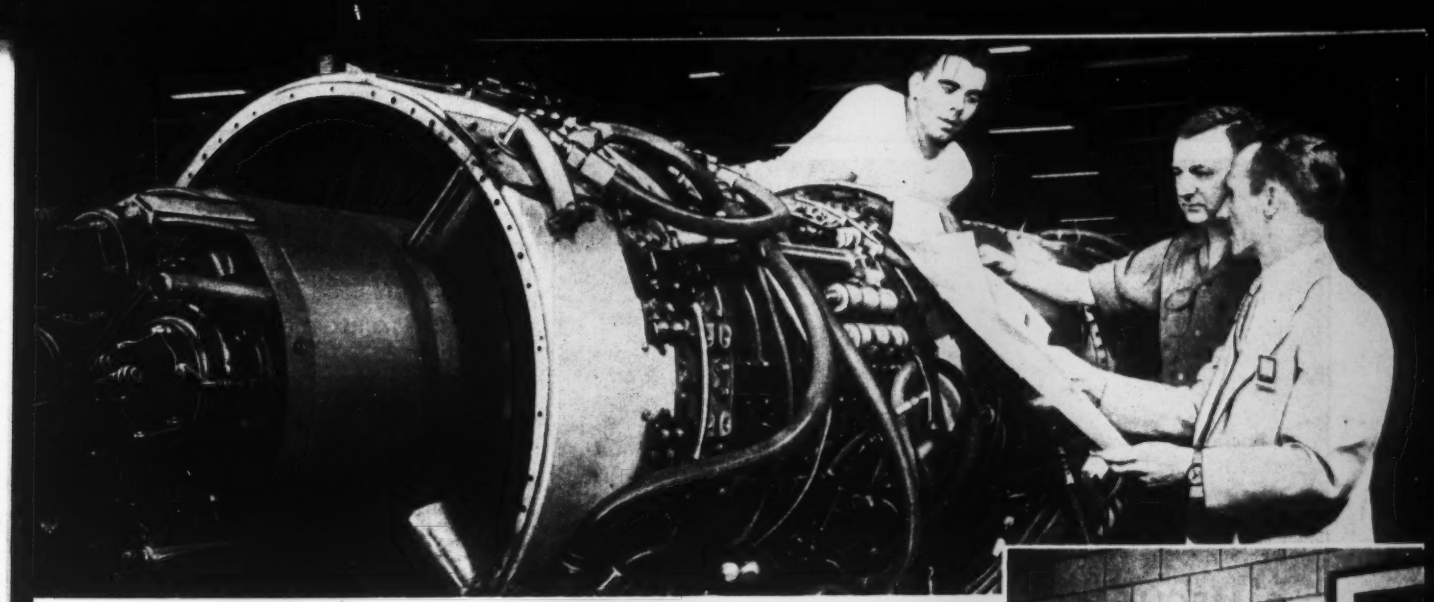
ENGINEERING DRAWING TEACHER—Take charge of drawing program including descriptive geometry and machine design. M.S. degree plus industrial experience. San Jose State College, San Jose, Calif.

Additional Opportunities are offered in the display advertisements—on pages 73, 74, 76, 100, 130



JET EXPERT — Ray Small, right, an Engine Project Manager, keeps close contact with his engineering personnel and with the engines that he is responsible for from development and testing through production and delivery.

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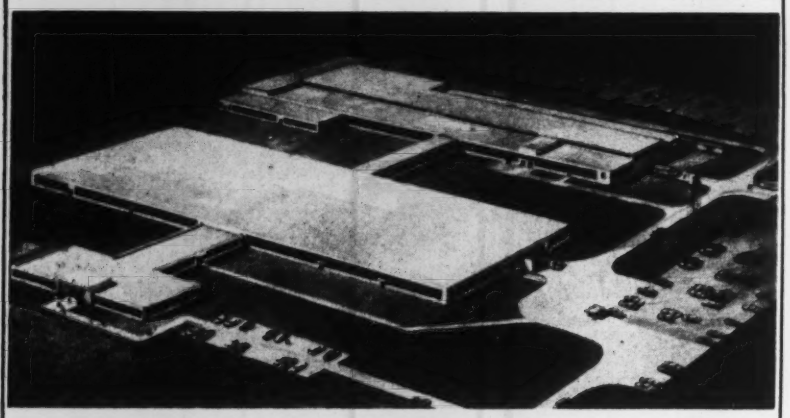

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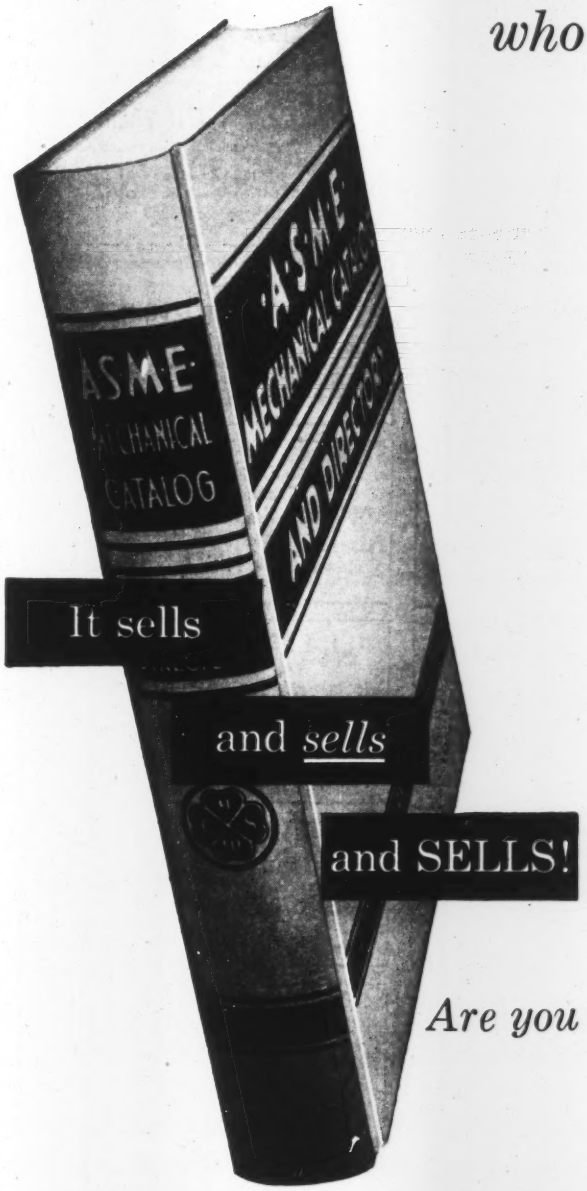

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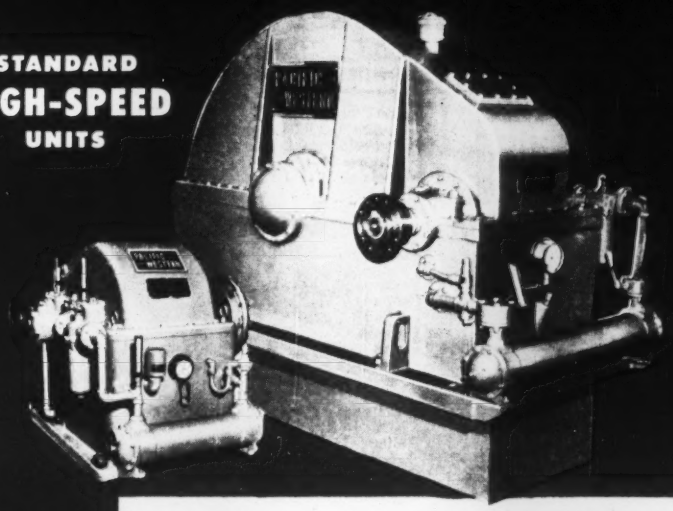

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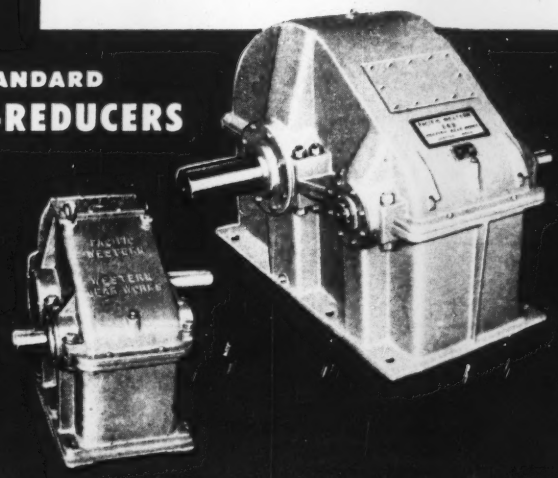

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*Air Preheater Corp.
*Aldrich Pump Co.
All American Tool & Mfg. Co.
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*Allis-Chalmers Mfg. Co.
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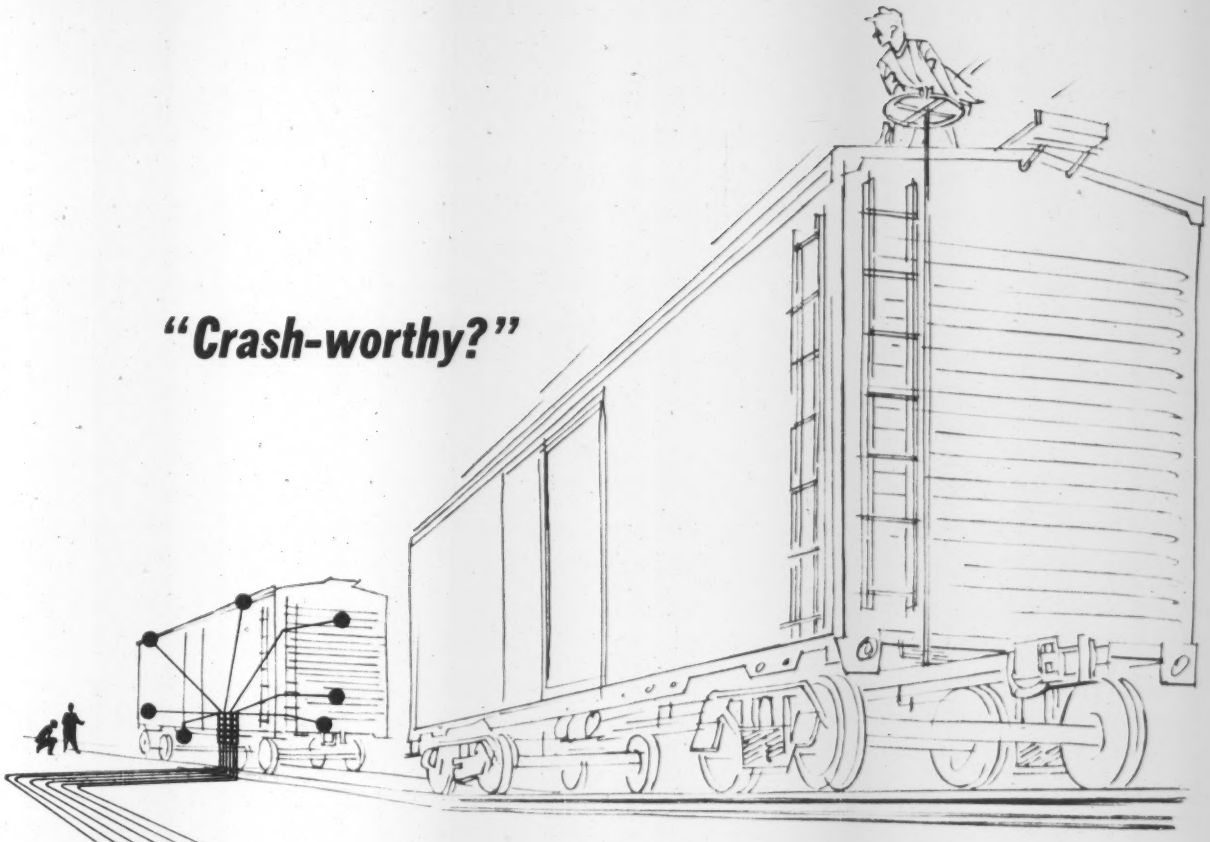
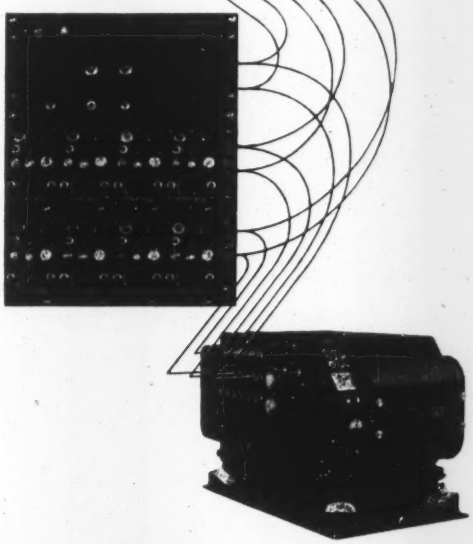




Pre-check with Consolidated Instrumentation

WHAT happens to structural members and car-body components when freight cars are subjected to the shock impacts and buffeting of hump-yard switching?

To determine stress distribution and to evaluate the effectiveness of shock protection devices, the Pullman-Standard Car Manufacturing Company selected a Consolidated 5-114 Recording Oscillograph, System D Amplifiers, and Bridge Balance as basic recording instruments.

Freight cars, loaded with sand and steel blocks at gross weights ranging from 46,400 pounds (empty) to 164,000 pounds (fully loaded) crashed together 185 times at speeds up to 10 miles per hour.

In this way the dynamics of simultaneous shocks, some as brief as one five-thousandth of a second, were permanently recorded in visual form. From such data will come design changes, giving protection against shock and vibration damage. Thus an improved product is achieved.

Consolidated Engineering
CORPORATION
300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.,** *a subsidiary with offices in: Pasadena, New York, Chicago, Washington, D. C., Philadelphia, Dayton.*

analytical instruments for science and industry

Dynamic Recording Systems such as the one shown here are designed and manufactured by Consolidated. Variations in the arrangement of the equipment are infinite. Applications are widely varied throughout industry and the sciences. A typical recording system includes pickups, amplifiers or bridge balances, and a recording oscillograph. Write for Bulletin CEC 1500B-X9

PACKAGED V-BELT FAN UNITS

BETTER FOR MANY AIR HANDLING APPLICATIONS

NEW! CLARAGE DEVELOPMENT

Clarage Ready Units are a notable advance in "packaged" fan units — highly efficient, compact, quiet in operation. And, like all other Clarage equipment, you can RELY on them for dependable, economical service.

MOTOR DRIVEN ASSEMBLIES—NO EXPENSIVE FOUNDATIONS REQUIRED

Clarage V-belt Ready Units come in 18 sizes — capacities to 12,000 c.f.m. . . . within their range, the ECONOMY ANSWER to almost any INDOOR or OUTDOOR air handling requirement.

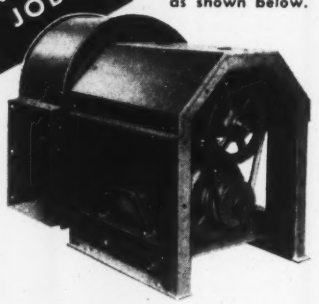
Use Ready Units and save the expense of building separate motor foundations. Use Ready Units and eliminate alignment problems. Use Ready Units for installations in record time and at lowest cost consistent with quality fan equipment.

Ready Units with or without Outdoor Covers shipped immediately. Specially constructed units for handling corrosive gases, etc., take a little longer.

WRITE FOR READY UNIT CATALOG 515 giving details, capacities and dimensions on the most modern "packaged" fan units available today — address, CLARAGE FAN COMPANY, Kalamazoo, Michigan.

INDOOR JOBS

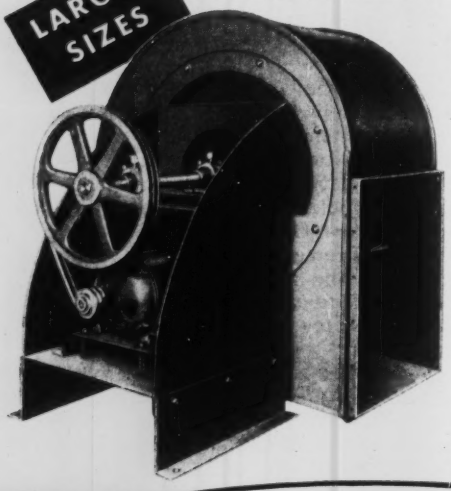
Standard Ready Units (except three largest sizes) afford protection to fan bearings, motor and drive as shown below.



OUTDOOR JOBS

Cut below shows Ready Unit equipped with (easily removable) Outdoor Covers shielding all working parts from rain and snow.

LARGER SIZES



Cut at left shows standard Ready Unit as built in three largest sizes. These larger units, too, can be equipped with Outdoor Covers.

68 PAGES OF VALUABLE INFORMATION

New Manual shows how to properly install and service Clarage fans, blowers and air conditioning units . . . valuable information adaptable to almost any type of fan job. Sent without charge to factory executives, engineers and maintenance officials.

You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

WORM GEARING—universal in its application—affords advantages for almost every power transmission job. Whether you want worm gearing sets or speed reducer units, you will find drives to meet your need in the complete Cleveland line.

Vickers Inc. hydraulic winch in operation on a Piasecki Hup-1 helicopter. Inset at left shows built-in Cleveland worm gearing.

Small Cleveland gearing speeds sea rescue

CLEVELAND worm gearing now has a part in a new kind of sea rescue. Just after the war, for the first time, a Vickers hydraulically-operated winch mounted on a helicopter hoisted two men to safety when an oil barge ran aground. Now use of the winch is standard practice, replacing hard-to-climb rope ladders previously used.

Vickers Inc. chose Cleveland worm gearing to drive the winch because it is small enough and light enough to satisfy rigid weight and bulk restrictions and is capable of governing efficiently sudden stops and starts and changes of direction involved in rescue work. To date Cleveland worm gearing has participated in over 1700 Korean missions.

Cleveland manufactures worm gearing and worm gear speed reducers in a wide range of types and sizes, large and small, to meet the requirements of any machinery builder or user. Write today for Catalog 400. The Cleveland Worm and Gear Company, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

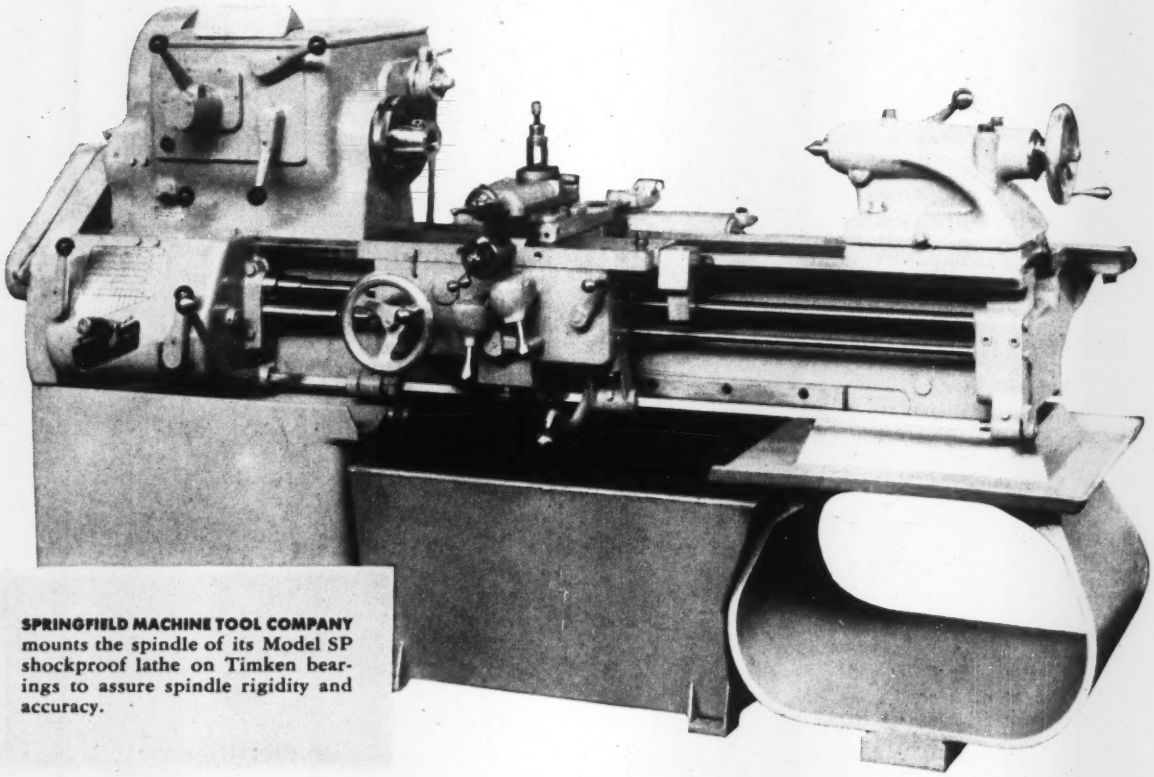
Sea-going lathe has sea legs for steadiness ...TIMKEN® bearings for precision

THIS new Springfield shockproof lathe is especially designed for high precision machine work while bolted to the deck of a naval vessel at sea. It has a radically different structure and special "sea legs" that prevent it from weaving when the deck flexes and enables the machine to withstand the severe shock of near misses and other combat-incurred stresses. Spindle rigidity and accuracy, essential for high precision work on land or sea, is maintained with Timken® precision tapered roller bearings.

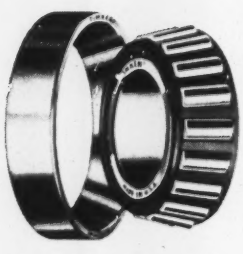
Timken precision bearings are especially designed for spindle applications. Run-out tolerances can be held to a maximum of 75 millionths of an inch. The tapered design of Timken precision bearings enables them to take both radial and thrust loads in any combination, holds spindles rigid and permits pre-loading to any desired degree to prevent chatter. Tapered design also makes Timken precision bearings easy and less costly to assemble (bench assembly is possible), and eliminates the need for special thrust bearings.

For the past 25 years, Timken precision bearings have been an important factor in the development of precision machine tools. Next time you buy or build a machine tool, be sure it's equipped with Timken precision tapered roller bearings. Always look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian Plant: St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



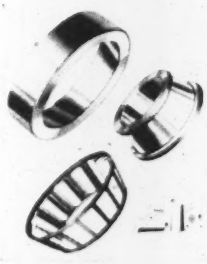
SPRINGFIELD MACHINE TOOL COMPANY mounts the spindle of its Model SP shockproof lathe on Timken bearings to assure spindle rigidity and accuracy.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



DESIGN LEADERSHIP

The first Timken tapered roller bearing was produced in 1898. Since then the one-piece multiple perforated cage, wide area contact between roller ends and ribs, and every other important tapered roller bearing improvement have been introduced by The Timken Roller Bearing Company.

The Timken Company leads in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▱ BEARING TAKES RADIAL ◨ AND THRUST → ◨ ← LOADS OR ANY COMBINATION → ◨ ←